

FM 6-88

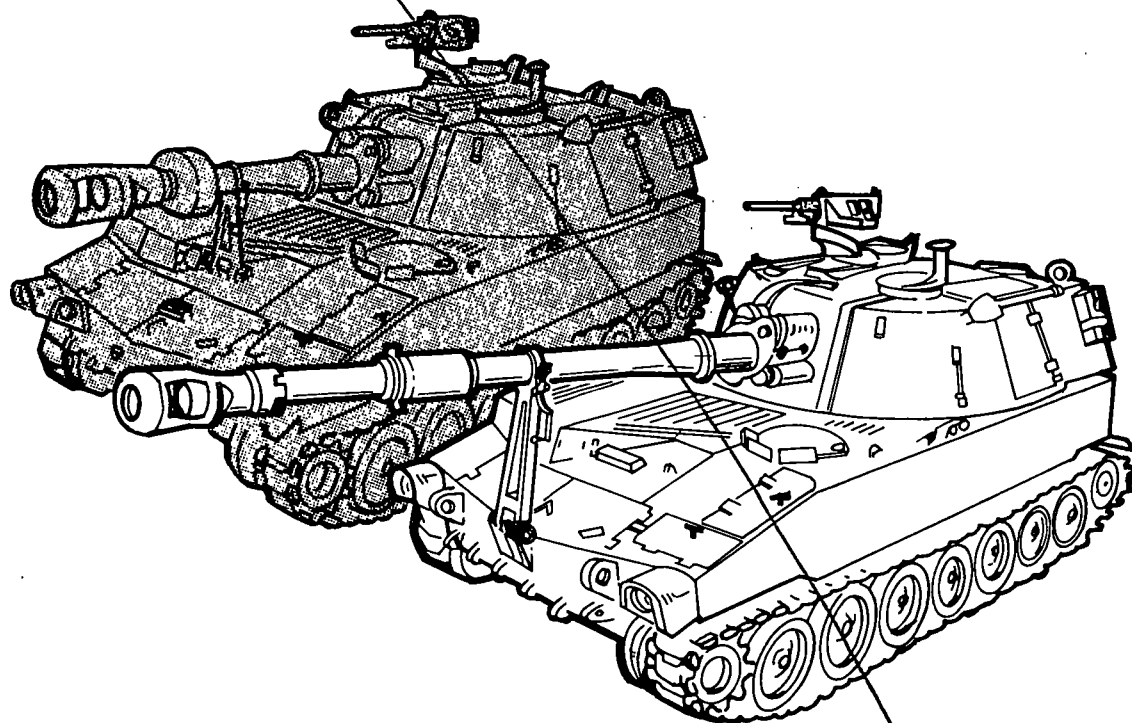
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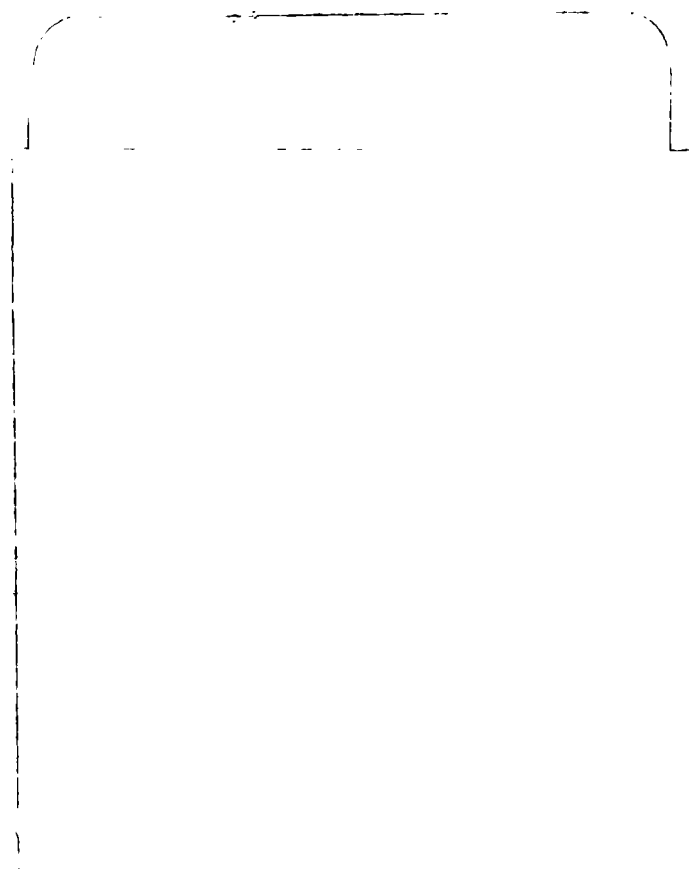
155-MM HOWITZER, M109, M109A1, SELF-PROPELLED



HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1974

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FIELD MANUAL

HEADQUARTERS

DEPARTMENT OF THE ARMY

No. 6-88

Washington, D.C. 28 June 1974

155MM HOWITZER M109 AND M109A1**SELF-PROPELLED**

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CHAPTER 1

GENERAL

1-1. Purpose and Scope

a. This manual is a guide to assist commanders in developing the howitzer sections of 155mm self-propelled M109 and M109A1 firing batteries into efficient and well disciplined teams. This manual lists individual duties and section drills, test and adjustments for howitzer equipment, maintenance and inspections, and instructions for destruction and decontamination of equipment. The material pertains to nuclear and nonnuclear warfare.

b. Users of this manual are encouraged to recommend changes or provide comments to improve it. Comments should be keyed to the specific page, paragraph, and line of text in which change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commandant, US Army Field Artillery School, ATTN: ATSF-CTD-DD, Fort Sill, Oklahoma 73503.

1-2. Definition of Terms

a. *Section*. The term section is intended to

designate only the personnel required to serve the weapon and its equipment. TOEs prescribe the personnel and equipment for each section.

b. *Front*. The front of a section is the direction in which the muzzle of the howitzer points.

c. *Right (Left)*. The direction right (left) is the right (left) when standing to the rear of the piece and facing the piece.

d. *In Battery*. A howitzer is in battery when the recoiling parts are in the normal firing position.

1-3. Description of Equipment

The motor carriages of the 155mm self-propelled howitzer M109 (fig. 1-1) and the M109A1 (fig 1-2) are the same. The main difference in the weapons is in the tubes. To insure proper use of the motor carriage and to avoid accidents caused by exceeding its capabilities and limitations, all members of the section should be familiar with the comparative characteristics shown in figure 1-3 and the performance characteristics shown in figures 1-4 and 1-5.



Figure 1-1. 155mm howitzer, M109, self-propelled.



Figure 1-2. 155mm howitzer, M109A1, self-propelled.

Table 1-3 Comparative Characteristic, 155mm Howitzer, 5P M109 and M109A1.

	M109	M109A1
Tube Length	156"	238"
Tube Life (EFC)	5,000 rds (M126) 7,500 rds (M126E1)	5,000 rds
EFC values	Zone 7 1.0 Zones 1-6 0.25	Zone 8 1.0 Zone 7 0.75 Zones 1-6 0.25
Muzzle velocity	564 mps (zone 7)	701 mps (zone 8)
Maximum range (M107)	14,500 m (zone 7)	14,600 m (zone 7) 18,000 m (zone 8)
Max chamber pressure (70° F)	36,400 psi (zone 7)	32,000 psi (zone 8)
Max rate of fire	4 rds/ min for 3 min	4 rds/ min for 3 min
Sustained rate of fire	1 rd/ min	1 rd/ min
Charges 1-7		1 rd/ min for 60 min.
Charges 8	Not applicable.	1 rd/ 3 min thereafter

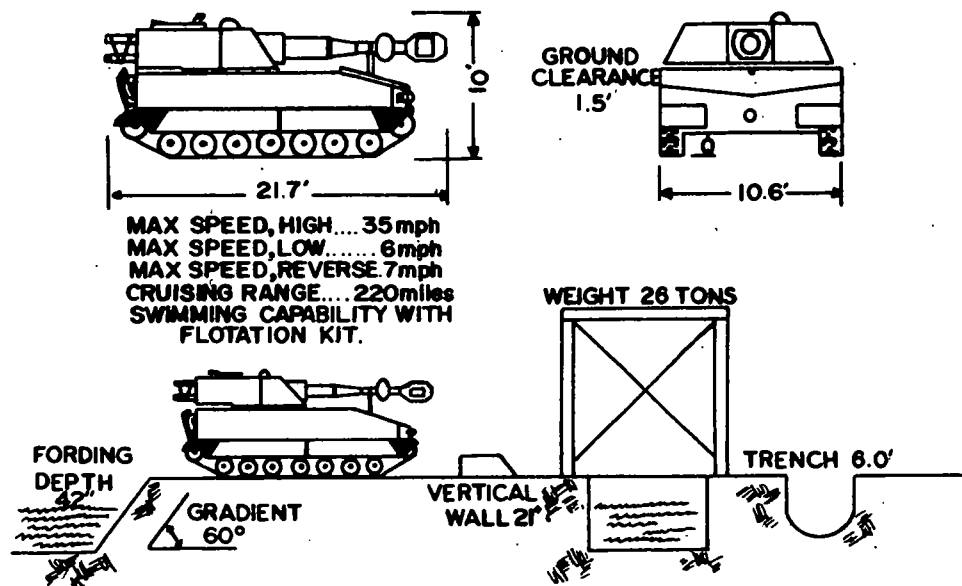


Figure 1-4. Performance characteristics, 155mm howitzer, 5P, M109.

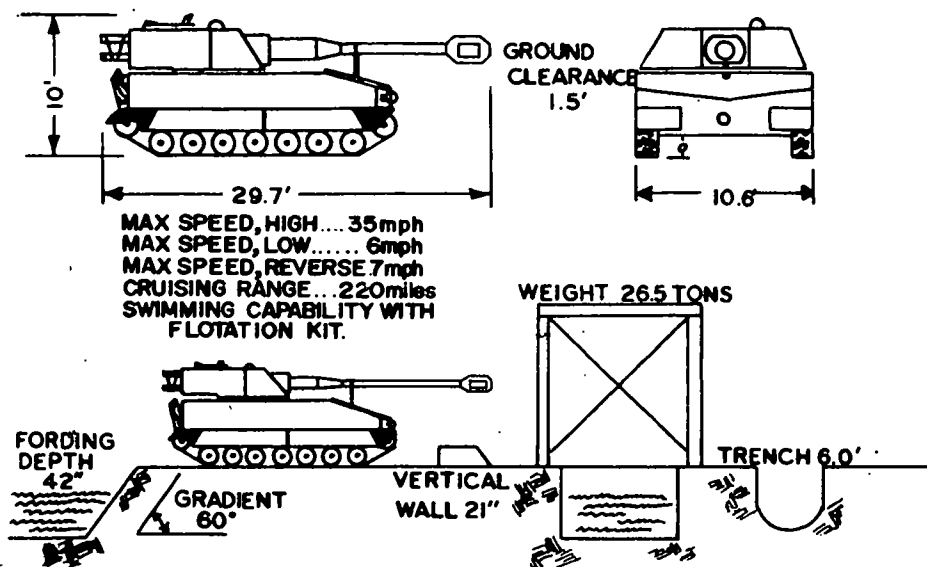


Figure 1-5. Performance characteristics, 155mm howitzer 5P, M109A1.



CHAPTER 2

ORGANIZATION

2-1. Composition of the Howitzer Section

a. The howitzer section consists of section personnel; a 155-mm, self-propelled, howitzer M109/M109A1; a section vehicle; and auxiliary equipment as listed in appropriate table of organization.

b. Personnel of the howitzer section consists of—

- (1) A chief of section (CS).
- (2) A gunner (G).
- (3) An assistant gunner (AG).
- (4) Five cannoneers, numbered 1 through 5.
- (5) A motor carriage driver (MD).
- (6) A section vehicle driver (SD).

2-2. General Duties of Personnel

a. *Chief of Section.* The chief of section is the noncommissioned officer in command of the section. He is responsible to the battery executive officer for—

- (1) Training and efficiency of personnel.
- (2) Performance of duties in section drill, duties in firing, tests and adjustment of sighting and fire control equipment, and inspection and maintenance of all section equipment, including the performance of scheduled preventive maintenance service on the motor carriage and section vehicle.
- (3) Observance of safety precautions.

(4) Preparation of field fortifications for protection of personnel, ammunition, and equipment.

(5) Camouflage, light and noise discipline; local security; and chemical, biological, and radiological (CBR) warfare security discipline.

(6) Maintenance of Equipment Log Book (TM 38-750).

(7) Police of the section area.

b. *Gunner.* The gunner is the principal assistant to the chief of section in performing the duties specified in *a* above. The gunner's main duties are detailed in this manual.

c. *Assistant Gunner.* The assistant gunner assists the gunner in performing his duties and, in an emergency, acts as the gunner. The assistant gunner's main duties are detailed in this manual.

d. *Cannoneers.* Cannoneers perform the duties listed in this manual and any other duties assigned by the chief of section.

e. *Drivers.* The drivers' primary duties are driving their vehicles and performing preventive maintenance. They also perform duties detailed by this manual and by the technical manuals pertaining to their vehicles, and other duties assigned by the chief of section. These duties can include substituting for any member of the section in firing.

CHAPTER 3

SECTION DRILL

Section I. GENERAL

3-1. Objective

The objective of section drill is to attain proficiency for the howitzer section through cross training of section personnel, precision in performance and execution of assigned tasks, and speed in section operation without sacrificing accuracy and safety.

3-2. Instructions

a. Adherence to drills shown in this manual is necessary to develop proficiency and to prevent injury to personnel and damage to equipment. Section drill must be conducted in silence, except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Errors are corrected immediately. Each member

of the section must be impressed with the importance of reporting promptly to the chief of section any errors discovered before or after the command to fire has been given. The chief of section will report errors immediately to the executive.

c. Battery officers supervise the drill to insure that commands are carried out and that efficiency is obtained.

d. Duties should be rotated during training so that each member of the howitzer section can perform all the duties within the section. In addition, battery overhead personnel not assigned specific duties during drill periods should be trained in the fundamentals of section drill in order that they will be capable of functioning with a howitzer section if required.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

3-3. To Form the Section

a. To Fall In. The chief of section takes his post. On the command of execution the section forms in a single rank, at close interval, centered on and facing the chief of section at a distance of 3 paces. Numbered cannoneers form in order between the assistant gunner and the motor carriage driver. The chief of section may indicate in his preparatory command the place and direction in which the section is to form. At the first formation for a drill or exercise, the caution "As howitzer section" precedes the command. The commands are FALL IN, or 1. IN FRONT (REAR) OF YOUR PIECE, 2. FALL IN. Execution is as follows: The section moves at double time and forms at close interval, at attention, guiding on the gunner. The driver of the section vehicle is to the left of the motor carriage driver and is the last in line. To execute 1. IN REAR OF YOUR PIECE, 2. FALL IN, the section falls in as shown in figure 3-1.

b. To Call Off. The section being in formation, the command is CALL OFF. At the command, all personnel in ranks (except the gunner, execute eyes right. The section then calls off in sequence; for example, "Gunner," "Assistant Gunner," "1," "2,"

"3," "4," "5," "MOTOR DRIVER," "SECTION DRIVER." Each man, except the gunner, turns his head smartly to the front as he calls out his designation.

3-4. To Post the Section

The command is 1. CANNONEERS, 2. POSTS. The command is general and is applicable whether the section is in or out of ranks, at a halt, or marching. All movements are executed at double time and are terminated at the position of attention. The section moves to posts as shown in the following figures:

- a.* Dismounted (fig 3-2.)
- b.* Mounted (fig 3-3.)
- c.* Prepared for action (fig 3-4.)

3-5. To Change Posts

To acquaint the members of the section with all duties and to lend variety to drill, posts should be changed often. The section being *in formation* (fig 3-1), the commands are 1. CHANGE POSTS, 2. MARCH, or 1. SECTION CHANGE POSTS, 2. MARCH.

a. At the command 1. CHANGE, POSTS, 2. MARCH, the assistant gunner and all numbered cannoneers except No. 5 take two left steps, taking

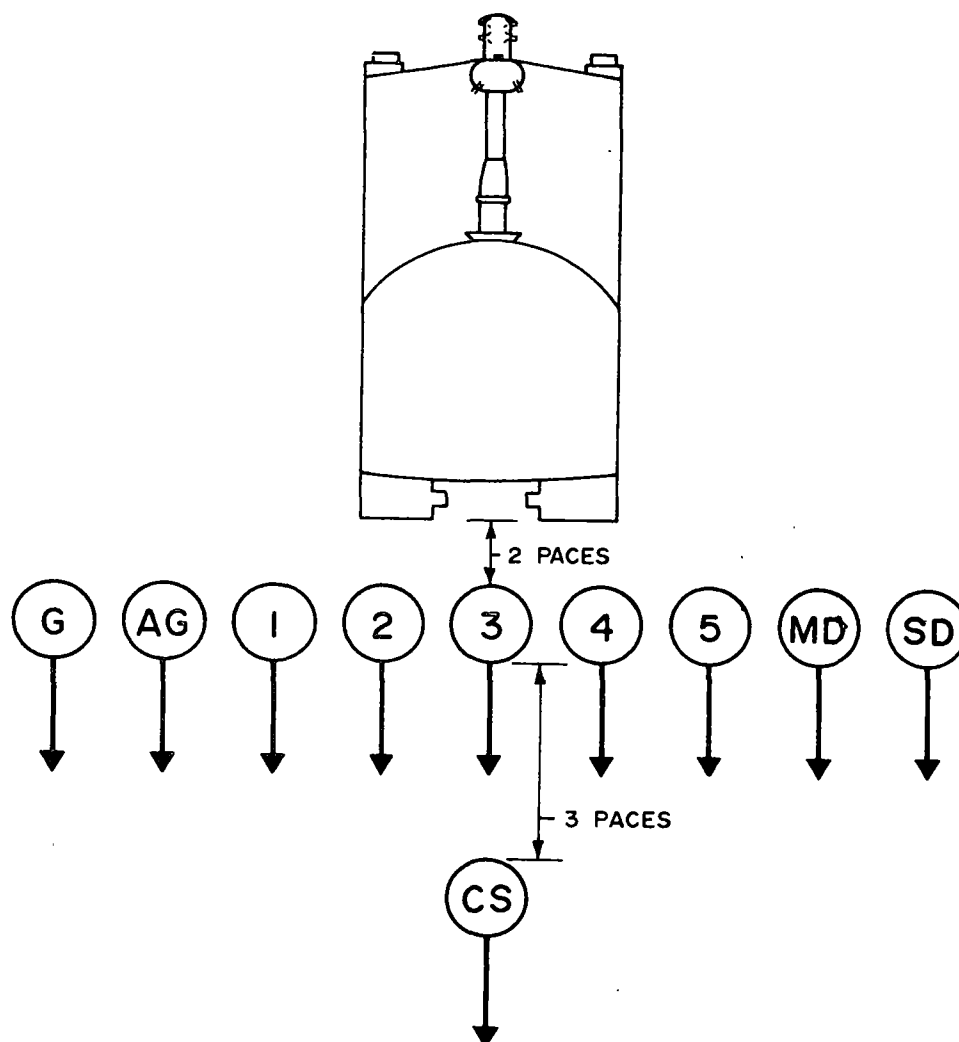


Figure 3-1. Formation of the section in rear of the piece.

the position of the next higher numbered cannoneer. At the same time No. 5 moves at double time in rear of the rank to the post of the assistant gunner. All other members of the section stand fast.

b. At the command 1. SECTION CHANGE POSTS, 2. MARCH, all members of the section except the individual at the extreme left take two left steps. The excepted man moves at double time in rear of the section and takes the post of the gunner.

3-6. To Mount

The commands are 1. PREPARE TO MOUNT, 2. MOUNT, or MOUNT.

a. At the preparatory command, the section moves at double time to the positions shown in figure 3-2. At the command of execution, all personnel mount as indicated in figure 3-3. The chief of

section, driver of the motor carriage, gunner, assistant gunner, and No. 1, mount on the motor carriage. Likewise, at the command of execution, the driver of the section vehicle, and No. 3, 4, and 5 mount into the section vehicle. If any members of the section are not to mount, their designation is announced with the caution, "Stand fast," given between the preparatory command the command of execution. For example, 1. PREPARE TO MOUNT, DRIVERS STAND FAST, 2. MOUNT.

b. If the command is MOUNT, the section mounts in the manner and order prescribed for the command 1. PREPARE TO MOUNT, 2. MOUNT.

3-7. To Dismount

The commands are 1. PREPARE TO DISMOUNT, 2. DISMOUNT, or DISMOUNT.

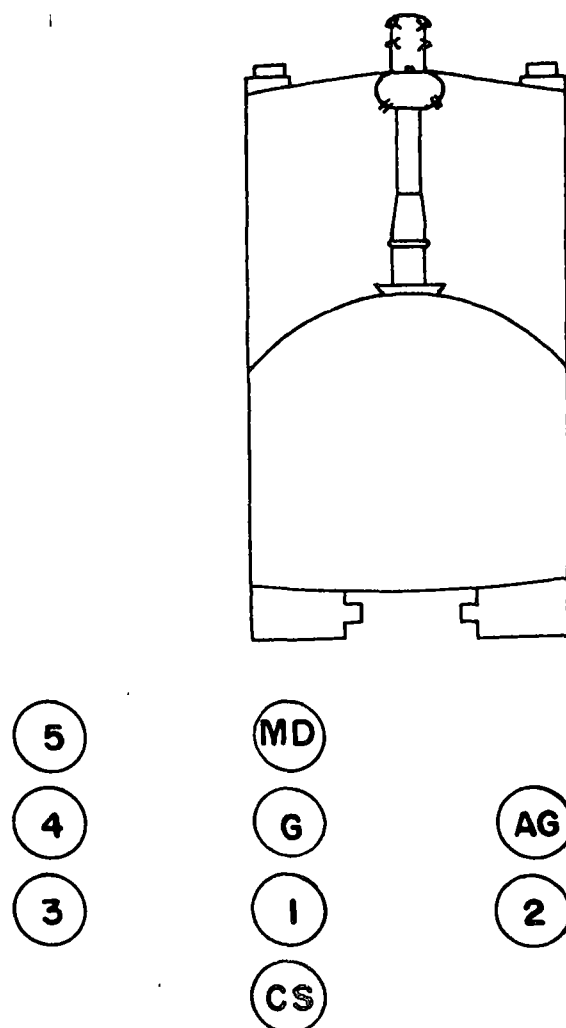


Figure 3-2. Posts, dismounted.

a. At the preparatory command, the personnel mounted in the section vehicle unlatch and open the doors (tailgate) of the vehicle and all members of the section assume positions from which they can

dismount promptly. At the command of execution, they dismount and take (at double time) the posts shown in figure 3-2.

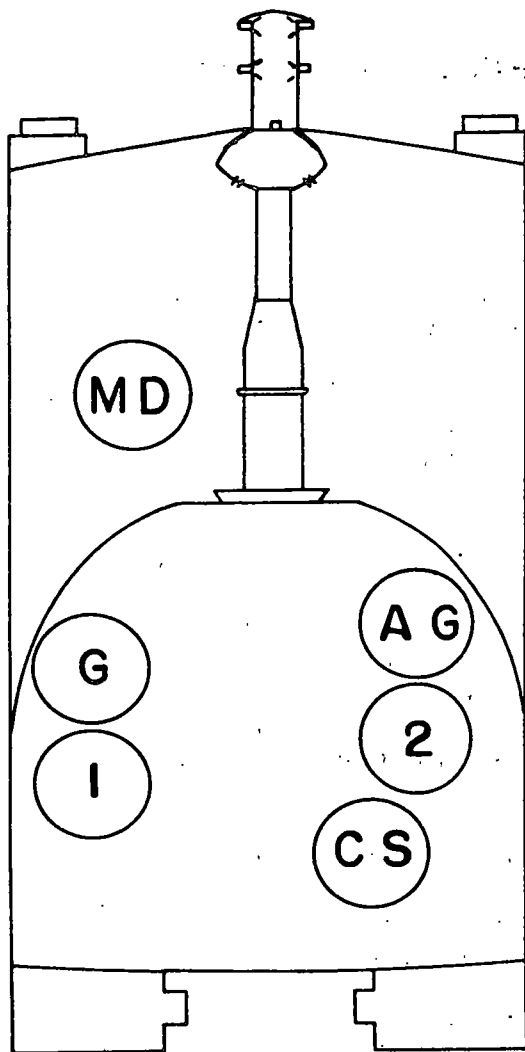


Figure 3-3. Posts, mounted.

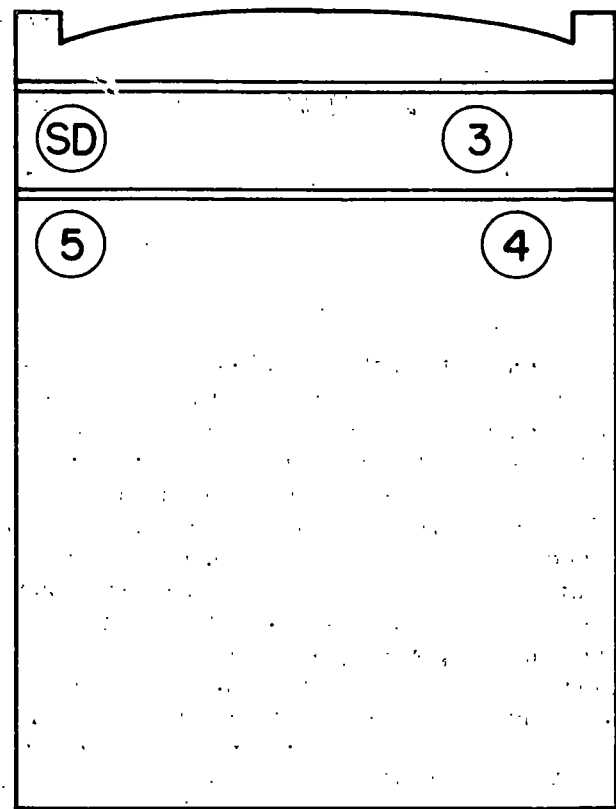


Figure 3-3—Continued.

b. If the command is DISMOUNT, the section dismounts in the manner and order prescribed for the command 1. PREPARE TO DISMOUNT, 2. DISMOUNT.

3-8. Break Periods During Training or Firing

a. *At Drill.* When it is desired to give the personnel a rest from drill or to relieve them temporarily from *formation or post*, the command *FALL OUT* is given. The command may be given at any time and means that the section is to remain in the drill area.

b. *When Firing.* When firing has been suspended temporarily, but it is desired to have the section remain in the vicinity of the motor carriage, the command *FALL OUT* is given. Men stand clear of the piece to insure that settings remain undisturbed. During these periods, the chief of section may direct the men to improve the position, to replenish ammunition, or to do other necessary work.

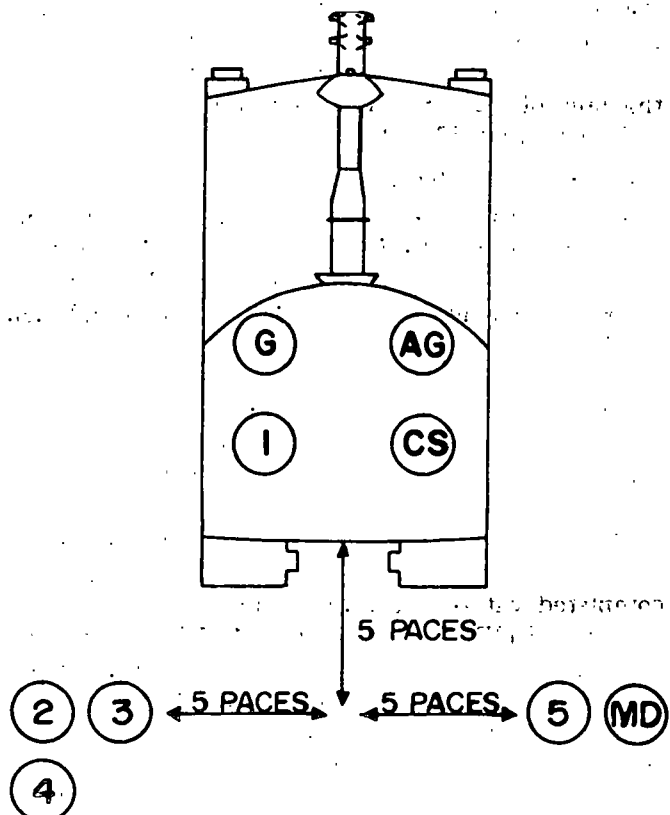


Figure 3-4. Posts, prepared for action.

CHAPTER 4

PREPARING THE PIECE FOR FIRING AND TRAVELING

Section I. PREPARATIONS FOR FIRING

4-1. General

The weapons if a battery will ordinarily be moved into positions individually under the direction of the battery executive officer, chief of firing battery, and chiefs of section. Preparation of firing positions prior to occupation is governed by time factors and unit SOP. To facilitate occupation of firing positions, two methods are suggested. One method is to mark the howitzer positions with metal stakes and engineer tape (or other visible markers) in the direction of fire to indicate along where the edge of the left track is to be driven. An additional stake may be placed along the engineer tape to approximate the position of the panoramic telescope when the howitzer comes to a halt. A second method is to drive a stake into the ground at a point where the center of each carriage is to be placed. Another easily identifiable stake should be placed in the direction of fire approximately 50 to 100 meters from the first stake so that the driver of the motor carriage can point the tube at the far stake as he drives the vehicle into position over the first stake. Each vehicle is halted at its proper place by the chief of section using hand signals as shown in FM 21-60 and TM 21-306.

4-2. To Prepare for Action

a. The piece being in position or approaching it, the command is **PREPARE FOR ACTION**. Duties of individuals are listed in paragraphs 4-3 through 4-11. Each man takes his post (fig 3-4) on completion of his duties.

b. The piece normally will be partially prepared for action before reaching the firing position. The duties of the cannoneers in preparing for action are the same whether the piece is moving or halted, but only the operations that are practicable are performed while moving. Immediately after the piece is established in position, preparation for action is completed without further command.

c. If **PREPARE FOR ACTION** has not been ordered before the piece is established in position, the command is always given by the chief of section as soon as the vehicle is halted in position. When preparation for action is not desired, the command **"DO NOT PREPARE FOR ACTION"** must be given.

*These steps may be omitted during training when drill does not include laying of the piece.

4-3. Duties of Chief of Section

a. Commands **PREPARE FOR ACTION**. Supervises work of cannoneers during all activities.

b. Directs backing of carriage upon spades; has driver set brakes.

Note. If a gun guide is not used, then chief of section will have the piece power shifted to within 10 mils before emplacing the spades.

c. Checks replenisher pressure gauge and recuperator guide pins. Check recoil system for leaks. Directs servicing, as required.

d. (*) Indicates alternate aiming point to the gunner when one is designated by the executive officer. The chief of section will assure himself of proper identification and point out the aiming point to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic telescope until the horizontal and vertical crosshairs are on the aiming point designated. If an alternate aiming point is not designated, the chief of section should select a clearly defined point at a distance of at least 1,500 meters. This aiming point is to be used as directed by the executive officer or at such times when the aiming posts and/or collimator are rendered useless. Deflections read from the azimuth counter are recorded and reported to the executive officer and are used to maintain parallelism, until the aiming post and/or collimator are reemplaced.

e. (*) Measures site to the crest assisted by the gunner:

(1) Sights along lowest element of bore.

(2) Directs the assistant gunner to elevate or depress the tube until the lowest element of the bore just clears the highest crest in the field of fire.

(3) Directs the assistant gunner to center the cross-level and elevation bubbles.

(4) Reads elevation on elevation counter and reports to the executive officer "Sir, number () site ()." (Gunner's quadrant may be used.)

(5) Records and announces minimum elevation for each charge to the gunner and Number 1.

f. Verifies the adjustments of the sighting and fire control equipment.

- g. Establish rough azimuth indicators.
- h. Verifies that the howitzer is prepared for action. Reports to executive officer "Sir, number () in order" or reports any defects that the section cannot remedy without delay.

4-4. Duties of the Gunner

- a. Depresses left pedal latch. (Pedal now in UP position.) Opens left cab door.
- b. Removes collimator and hands it to No. 4 man. Releases cab traverse lock. Places cab power switch to ON, checks position of traverse control switch, power or manual as desired, and selects gunner position for power elevation. Checks equilibrator fluid level.
- c. On driver's command elevates tube clear of howitzer traveling lock and then depresses tube to minimum elevation for No. 5 man. Selects No. 1 Man position for power elevation. Checks power and manual traverse mechanism. Commands driver to lift and lock ballistic cover.
- d. Installs panoramic telescope (panel). Uncovers azimuth 6,400-mil counter and zeros the gunner's aid counter. Levels telescope mount.
- e. Lays the piece for direction. The piece being in position, tube in the center of traverse and not laid for direction, the executive officer commands *BATTERY ADJUST AIMING POINT THIS INSTRUMENT*. The gunner replies "Number (so-and-so) aiming point identified," the executive officer commands *NUMBER (SO-AND-SO) DEFLECTION (SO MUCH)*. The gunner repeats the command, opens the door of the azimuth counter and sets the commanded deflection on the azimuth counter dial. With the tube in center of traverse, the chief of section directs the piece to be power shifted to within 10 mils of the announced deflection. The piece is then backed on the spades and the gunner traverses the tube until the vertical crosshair of the telescope is centered on the executive's aiming circle. He checks to insure that the bubbles are centered and announces "Number (so-and-so) ready for recheck". As additional deflections are commanded by the executive officer, the gunner repeats the commands and announces the number of mils difference between the new and previously announced deflection. The gunner then traverses the tube until the vertical crosshair is centered on the executive's aiming circle and announces, "Number (so-and-so) ready for recheck," unless the executive announces "Number (so-and-so) is laid". When the executive announces "number (so-and-so) is laid," the tube has been oriented and should not be traversed except on order of the executive. The gunner records the deflection that has been set on the azimuth counter dial.

f. Directs alinement of aiming posts and/or collimator: The piece having been laid, the gunner rotates the head of the panoramic telescope to deflection 2600 or the prescribed deflection. Directs Number 4 by hand signals to aline the collimator. Directs Number 5 by hand signals to aline near aiming post with the far aiming post and the vertical reticle. After the aiming posts and collimator have been alined, the gunner records the azimuth to the aiming posts, closes the door and turns the reset knob, setting 3200 on the azimuth reset counter dial. All subsequent deflections are read from the azimuth reset counter dial.

Note. The azimuth counter is used to lay the howitzer. The reading in this window reflects the angle required to place the tube parallel to the direction of fire. The reset counter is then used to establish a common deflection of 3,200.

- g. Refers telescope to alternate aiming point.

- (1) The piece has been laid.
- (2) The executive may command *AIMING POINT, LEFT FRONT, LONE TREE, REFER*.
- (3) Without moving the tube, refers the sight to the aiming point.
- (4) Reads the deflection from the azimuth counter and reports "NUMBER (), DEFLECTION ()."
- (5) Records reading in azimuth counter window and closes the windows.

Note. The executive officer may record the referred deflection for future use.

- h. Assists chief of section in measuring site to crest.
- i. Tests and alines (boresight) fire control equipment.

4-5. Duties of the Assistant Gunner

- a. Depress right pedal latch. (Pedal now in UP position.) Opens right cab door.
- b. Checks functioning of elevating mechanism (power and manual).
- c. Depresses or elevates tube to loading elevation on elevation quadrant and centers cross-level bubbles. Sets correction counter to zero.
- d. Checks direct fire telescope.
 - (1) Adjusts eyepiece arm to a convenient viewing angle.
 - (2) Adjusts light control knob for optimum reticle illumination.
 - (3) Adjusts level-vial mirror for convenient viewing.
 - (4) Centers cant correction bubble by turning the red cant correction knob.
 - (5) Verifies that elevation and azimuth slip scales are set at 4; this centers the scale.
- e. Assists chief of section in measuring site to crest.

f. Tests and aligns (boresight) fire control equipment.

4-6. Duties of No. 1 Cannoneer

a. Opens rear cab door. Removes left spade strut safety pin. Releases left locking latch and lowers spade to ground.

b. Procures lanyard, and operates firing mechanism. Inspects, operates and cleans the breechblock, power rammer, chamber, bore and primer vent and leave the breechblock open. Places vent cleaning bit in a convenient location.

Note The breechblock must be opened for initial round. For subsequent rounds, the breechblock opens automatically.

c. Procures sponge, burlap, and a bucket of water and places them in a convenient location. Procures primers and places them in a convenient location.

4-7. Duties of No. 2 Cannoneer

a. Opens hull door, then closes hull door. Removes right spade strut safety pin. Releases right locking latch and lowers spade to the ground. After the weapon is upon the spades he reopens the hull door.

b. Assists No. 1 in inspecting and cleaning the breechblock chamber, bore, primer vent and power rammer.

c. Procures fuze setters. Assisted by No. 3, unloads fuze boxes and opens and arranges fuzes as directed by the chief of section.

d. Constructs shelters with tarpaulins.

4-8. Duties of No. 3 Cannoneer

a. Carries section gear from ammunition carrier to piece as directed by Chief of Section.

b. Spreads tarpaulins to rear of piece. (Tarpaulins will be used to construct shelters. On left for projectiles. On the right for propellant.) Assists No. 2 in unloading fuze boxes and opening and arranging fuzes.

c. Assists No. 4 and 5 in unloading and arranging ammunition.

d. Constructs shelters with tarpaulins.

4-9. Duties of No. 4 Cannoneer

a. Carries section equipment from section carrier to piece as directed by Chief of Section. Obtains collimator from gunner and places it to left front of howitzer.

b. Assists No. 3 in preparing tarpaulins. Assembles aiming posts and places them to right rear of the piece for No. 5. Receives rammer staffs

and other section gear as the driver hands it down. Assembles rammer staffs and arranges gear to right side of the piece.

c. Unloads and arranges projectiles as directed by the chief of section.

d. Aligns collimator with directions from the gunner.

e. Constructs shelters with tarpaulins.

f. Emplaces and holds testing target, if required.

4-10. Duties of No. 5 Cannoneer

a. Acts as gun guide for the section. He goes forward with the recon party and will emplace and align the howitzer marking stakes in the direction of fire. He will be given the deflection to the forward stake. Necessary wire will be carried forward to establish section-battery communications upon arrival of the piece.

b. Guides the piece into position parallel with stakes and stops it where the aiming point, forward stake, and pantel will be aligned when the weapon is backed upon the spades. Plugs the piece into the battery communication system.

c. Removes muzzle plug and tosses it in driver's hatch.

d. Unload and arrange equipment as directed by the chief of section.

e. Unloads and arranges propelling charges as directed by the chief of section.

f. Aligns aiming posts with directions from the gunner.

g. Constructs shelters with tarpaulins.

4-11. Duties of the Motor Carriage Driver

a. When directed by chief of section backs carriage upon spades and sets the brakes. Allows the engine to idle at 1000-1200 RPM until coolant temperature drops below 185° before stopping engine. Leaves master switch ON. Disengages the howitzer traveling lock and commands the gunner to elevate. On the gunner's command lifts and locks the ballistic cover.

b. Opens and locks direct fire telescope window. Removes and stores tarpaulins. Removes aiming posts, rammer staff sections and pioneer equipment as needed. Uncovers front recuperator guide pins.

c. Puts instrument panel inside driver's compartment and closes hatch. Checks to insure all hatches are secured. Covers recuperator guide pins.

d. Constructs shelters with tarpaulins.

Section II. PREPARATIONS FOR TRAVELING

4-12. March Order

To prepare for movement, the command is MARCH ORDER. Duties of individuals are listed in

paragraphs 4-14 through 4-22. Each man takes his post (fig 3-3) on completion of his duties.

4-13. To Resume Firing in Another Position

a. If the piece is to be moved a short distance and if firing is to be resumed promptly, the command *MARCH ORDER* is not given. When such a displacement is ordered, only those operations necessary for the movement of the motor carriage and the security of equipment are performed.

b. If the command *MARCH ORDER* is given while the weapon is prepared for travel as in a above, the operations pertaining to march order are completed. If the command is simply *DISMOUNT*, the section executes all that is prescribed for the command 1. *PREPARE TO DISMOUNT*, 2. *DISMOUNT*.

4-14. Duties of Chief of Section

a. Commands *MARCH ORDER*. Inspects chamber to see that the howitzer is not loaded. Supervises the work of the section.

b. Directs driver in extracting spades.

c. Verifies that the howitzer is prepared for traveling. Takes post.

d. Reports to executive "Number () in order" or reports any defect that the section cannot remedy without delay.

4-15. Duties of the Gunner

a. Sets azimuth counter to 3,200 mils and closes window. Sets gunner's aid counter to zero. Covers bubbles on the telescope mount.

b. Removes the panoramic telescope from its mount and replaces it in its case. Stores collimator in appropriate place.

c. Assists the driver in engaging howitzer travel lock. Places cab power switch to OFF. Locks cab traverse lock.

d. Steps on left and right release pedals, respectively, after driver has backed against the spades. Makes sure pedal latch engages pin. Closes left cab door. Verifies that all section equipment is present and secure.

4-16. Duties of the Assistant Gunner

a. Sets correction counter to zero and elevation counter to zero. Covers bubbles on the range quadrant.

b. Closes right cab door.

c. Takes post.

4-17. Duties of No. 1 Cannoneer

a. Closes the breechblock after the chief of section has inspected the chamber. Secures the power rammer.

b. Replaces unused primers in traveling compartments.

c. Secures sponges, burlap and cleaning materials.

d. Assisted by Number 3, lifts the left spade into

the travel position.

Warning: Check locking latches for complete engagement. Replace left spade strut safety pin. Secure left and right strut respectively. Close rear cab door.

e. Takes post. Closes rear hull door after the chief of section has taken his post.

4-18. Duties of No. 2 Cannoneer

a. Replaces fuzes in containers and places them in howitzer compartment.

b. Returns fuze wrench and fuze setter to their traveling chest. Replace ammunition in the howitzer compartment.

c. Replaces vent and primer seat cleaning tools.

d. Assisted by Number 4, lifts the right spade into the travel position. Replace right spade strut safety pin.

e. Takes post.

4-19. Duties of No. 3 Cannoneer

a. Checks that projectiles are ready for loading, all fuzes are removed, and lifting plugs are replaced.

b. Assists Number 1 in lifting the left spade into the travel position. Assisted by Number 4, folds and stows tarpaulins in turret racks.

c. Takes post.

4-20. Duties of No. 4 Cannoneer

a. Recovers and hands collimator to gunner for storage.

b. Assists Number 2 in lifting the right spade into the travel position. Assists Number 3 in folding and stowing tarpaulins.

c. Takes post.

4-21. Duties of No. 5 Cannoneer

a. Assist in reloading ammunition and section equipment.

b. Recovers and disassembles aiming posts and hands to driver for storage.

c. Secures communication equipment.

d. Takes post.

4-22. Duties of Motor Carriage Driver

a. Replaces muzzle plug.

b. Disassembles and secures rammer staff sections. Secures aiming posts and pioneer tools. Closes and secures ballistic cover.

c. Lifts howitzer travel lock to the vertical position and, assisted by the gunner, locks tube in the traveling position. Closes direct fire telescope window.

d. Starts engine and backs against spades as directed by the chief of section. Drives vehicle forward as directed by the chief of section to extract spades. Remains in drivers compartment unless otherwise directed.

CHAPTER 5

FIRING BY INDIRECT LAYING

Section I. GENERAL

5-1. Method of Engagement

The vast majority of targets will be attacked by indirect laying, which is a method of taking targets under fire by placing the line of sight of the panoramic telescope on an aiming point other than the target. Aiming point used may be the collimator (fig 5-1), aiming posts or distant aiming point. To provide timely and accurate fire, the section must be indoctrinated with a sense of urgency. Proper emplacements of aiming points are discussed in chapter 7.

5-2. Duties of Individuals

In general, the indirect fire duties of individuals in the section are listed in *a* through *j* below. A detailed list of duties is contained in paragraph 5-21 through 5-28.

a. The chief of section supervises and commands the section, and is responsible that all duties of the section are performed properly, all commands are executed, and all safety precautions are observed.

b. The gunner sets the announced deflection, lays

for direction, refers the panoramic telescope, aligns the aiming posts or collimator (whichever is appropriate), assisted by No. 4, operates the power-manual traversing mechanism, and announces "Ready." after the howitzer is laid for direction and the assistant gunner has called "Set."

c. The assistant gunner sets the announced elevation, lays for elevation, operates the power-manual elevating mechanism, and calls "Set" when the howitzer is laid for elevation.

d. No. 1 loads and fires the howitzer.

e. No. 2 fuzes the projectile and sets the designated time or fuze selection as announced.

f. No. 3 inspects and cleans the projectiles and assists No. 2 in fuzing the projectiles.

g. ~~No. 4 carries projectiles to the howitzer.~~

h. No. 5 prepares the propellant charges, assisted by the motor carriage driver.

i. The motor carriage driver assists number 5 in preparing the propellant charge, and carries the ~~charge to the howitzer.~~

j. The section vehicle driver performs duties as assigned by the chief of section.

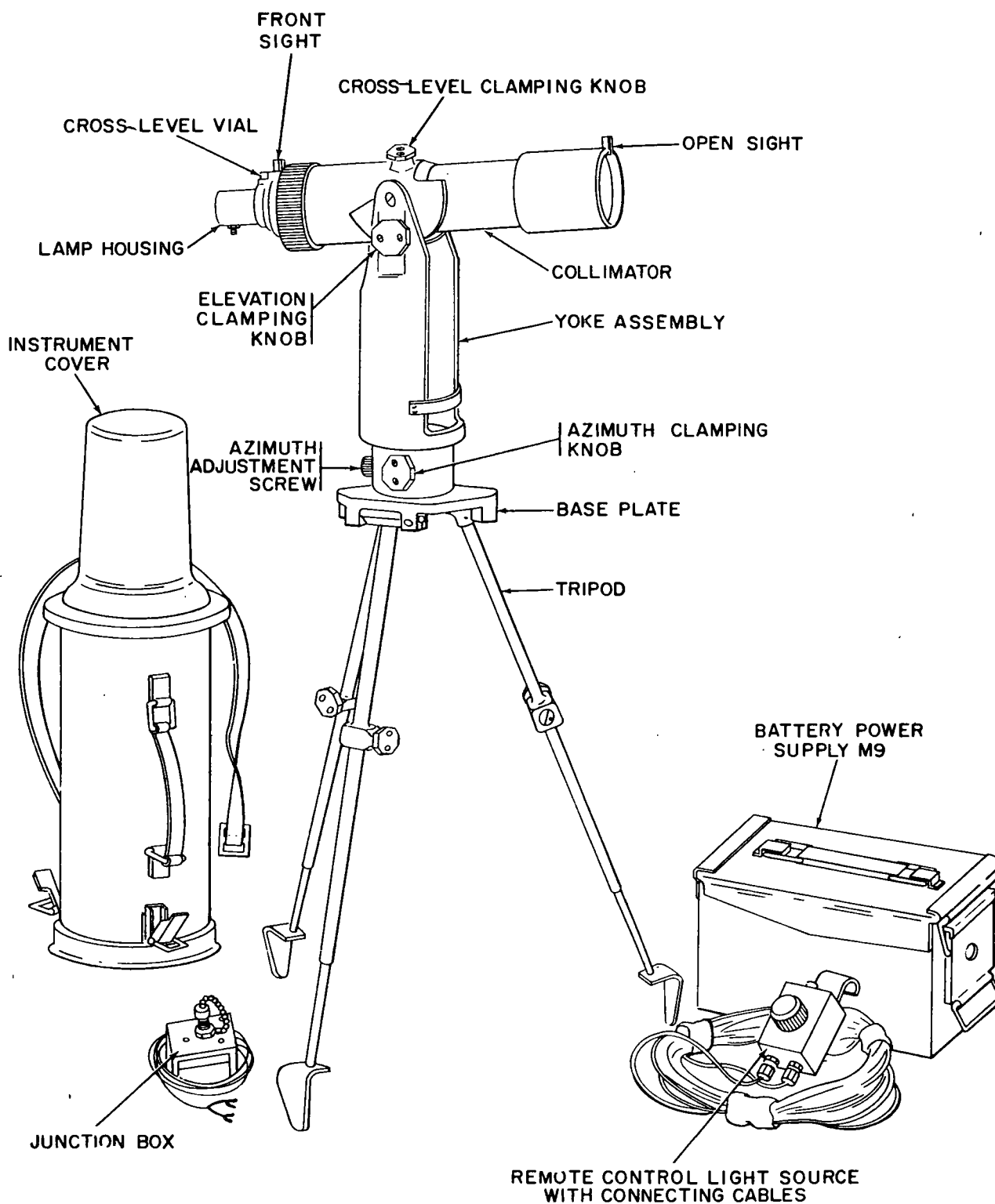


Figure 5-1. Infinity-aiming reference collimator and auxiliary equipment.

Section II. DUTIES OF CHIEF OF SECTION

5-3. Follows Fire Commands

The chief of section will follow fire commands. He will repeat the commands as required.

5-4. Indicates When the Piece Is Ready To Be Fired

When the executive can see arm signals made by the chief of section, the chief of section will raise his right arm vertically as a signal that the piece is ready to be fired. He gives the signal as soon as the gunner calls "Ready" and No. 1 has attached the lanyard. When arm signals cannot be seen, the chief of section reports orally to the executive, "Number (so and so) ready."

5-5. Gives the Command to Fire

When No. 1 can see the arm signals made by the chief of section, the chief of section will give the command to fire by dropping his right arm sharply to his side. When his arm signals cannot be seen, he commands orally number (SO AND SO), FIRE. The chief of section will not give the signal or command to fire until all cannoneers are in their proper places.

5-6. Reports Errors and Other Unusual Incidents of Fire to the Executive

a. If the piece cannot be fired, the chief of section will promptly report that fact to the executive and the reasons therefor; for example, "Number (so and so) out; misfire." When it is discovered that the piece has been fired with an error in laying, the chief of section will report that fact at once; for example, "Number (so and so) fired deflection (so and so)." When the gunner reports that the aiming posts are out of alignment, the chief of section will report that fact and, during the next lull in firing, ask permission to realine them by saying "Number (so and so) requests permission to realine aiming post." Likewise, the chief of section promptly reports other unusual incidents that affect the service of the piece.

b. If the zero line on the collimator cannot be seen by the gunner due to displacement of the weapon, he will continue to lay his piece on the collimator, taking up the correct sight picture (para 7-4).

5-7. Records Basic Data

The chief of section will record data of a semipermanent nature in a notebook. These data include minimum elevations; aiming points used and their deflections; prearranged fires when section data sheets are not furnished; safety limits in elevation and deflection; date, hour, and number of rounds fired; and calibration and special corrections when appropriate.

5-8. Lays the Piece for Quadrant When Gunner's Quadrant is Used

a. Although the normal method of laying for elevation is by use of the elevation counter, the gunner's quadrant may be used to lay for elevation when a refinement greater than 1 mil is desired. The gunner's quadrant is also used to check the accuracy of the elevation counters. The command is *USE GUNNER'S QUADRANT*.

b. When the announced elevation has been set on the gunner's quadrant, the piece has been loaded, and the breechblock has been closed, the gunner's quadrant is set on the quadrant seats of the elevation quadrant M15. The words *line of fire* must be at the bottom of the quadrant with the arrow pointing toward the muzzle. The chief of section must be sure to use the arrow which appears on the same side of the quadrant as the scale which he is using. He stands squarely opposite the side of the quadrant and holds it firmly on the quadrant seats parallel to the axis of the bore. *It is important that he take the same position and hold the quadrant in the same manner for each subsequent setting, so that in each case he will view the quadrant bubble from the same angle.*

c. The chief of section then directs the assistant gunner to elevate or depress the tube until the bubble is centered. The chief of section cautions the assistant gunner when the bubble approaches the center, so that the final centering may be performed accurately.

5-9. Measure the Quadrant

At the command *MEASURE THE QUADRANT*—the piece having been laid—the chief of section directs the assistant gunner to check the leveling of the elevation quadrant mount. The chief of section then sets the micrometer of the gunner's quadrant at zero and places it on the quadrant seats of the elevation quadrant mount—

a. Moves the plunger arm of the gunner's quadrant until the bubble passes to the end of the vial away from the plunger arm hinge.

b. Slowly lowers the plunger arm until the bubble just passes to the end of the vial toward the hinge.

c. Turns the micrometer until the bubble is accurately centered.

d. Removes the gunner's quadrant and reports the quadrant to the nearest 0.1 mil as "Number (so and so), (so much)."

5-10. Conducts Prearranged Fires

When the execution of prearranged fires is ordered, the chief of section conducts the fire of his section in conformity with the prescribed data.

5-11. Observes and Checks Functioning of the Materiel

The chief of section closely observes the functioning of all parts of the materiel during firing. Before the piece is fired, he insures that the recoil and counterrecoil systems contain the proper amount of oil; thereafter he carefully observes the functioning of these systems. He promptly reports to the executive any evidence of malfunctioning.

5-12. Assigns Duties When Firing With Reduced Personnel

When the number of personnel serving the piece is temporarily reduced below that indicated in this manual, the chief of section will assign duties to best facilitate the service of the piece. Loss of cadremen, various details, and casualties will necessitate the section's operating with a reduced number of personnel to the extent that it is almost normal for section members to double up on duties. Around-the-clock firing will require the chief of section to divide the section into shifts to provide for relief.

5-13. Verifies the Adjustment of the Sighting and Fire Control Equipment

See TM 9-2350-217-10 for detailed instructions on testing and adjusting sighting and fire control equipment.

5-14. Controls the Movement of the Motor Carriage

When it is necessary to move the motor carriage, the chief of section instructs the driver to start the engine. He then controls the displacement of the motor carriage by hand signals or by oral instructions. To shift the carriage when a new direction of fire is designated, the motor carriage should be moved so that when the tube is pointed in the new direction and the spade is seated the panoramic telescope will be over its original position and the aiming posts, or the collimator, will still be in alinement.

5-15. Checks All Ammunition Which Has Been Prepared for Firing Before It Is Loaded for Travel

The chief of section personally checks all ammunition not fired that has been prepared for firing before it is replaced in containers. He sees that powder increments prepared for firing are present in proper condition, are of the same lot number as the container, and are assembled in proper numerical order. He checks all time and/or proximity fuzes that have been set to see that they are reset to *SAFE* and that the eyebolt lifting plugs are reinstalled in all projectiles. The chief of section also insures that the supplemental charge has been replaced and that grommets are replaced on the rotating bands of projectiles.

Warning: Projectiles and fuzes that have been rammed and then removed from the tube will not be reloaded or fired. Put these aside for turn-in to EOD.

Section II. DUTIES OF GUNNER

5-16. Sets or Changes the Deflection

The command is *DEFLECTION (SO MUCH)*. If, for example, the command is *DEFLECTION 3283*, the gunner repeats deflection 3283 and then rotates the azimuth knob in the appropriate direction until 3283 is set on the azimuth reset counter dial. The gunner then traverses the piece until the vertical crosshair of the reticle is on the left edge of the aiming posts or the center line of the collimator, or on a designated aiming point. Final motion for traversing is accomplished using the hydraulic traversing system and is always from left to right.

5-17. Centers the Cross-Level Bubble on the Panoramic Telescope Mount

The gunner centers the cross-level bubble on the telescope mount as part of all operations that involve the use of the panoramic telescope. This bubble is centered prior to using the telescope and the level of

the mount is verified before the gunner calls "Ready".

5-18. Calls "Ready"

After the piece has been loaded, primed, and laid in both direction and elevation and is ready to be fired, the gunner calls "Ready", by shouting to signify that the piece is ready to be fired.

5-19. Lays the Piece for Elevation When Directed To Do So By The Chief of Section

The piece is normally laid for elevation by the assistant gunner. However, when circumstances make it desirable for the gunner to lay for elevation, he may do so by using the elevation counter which is a part of the telescope mount and operating the power elevating mechanism. To lay for elevation, the gunner sets the announced quadrant on the elevation counter dial and elevates (or depresses) the tube using the power elevating mechanism until the

elevation level bubble is centered. He must also insure that the crosslevel bubble is centered.

5-20. Refers the Panoramic Telescope When Directed by Executive Officer

The command is *AIMING POINT THIS INSTRUMENT (OR OTHER POINT), REFER.* Without disturbing the laying of the piece, the gunner turns the panoramic telescope until, with the elevation and cross-level bubbles centered, the

vertical crosshair of the reticle is on the point designated. He then opens the door of the azimuth counter dial, reads the deflection on the azimuth counter and reports to the executive. "Number (so-and-so) deflection (so much)."

5-21. Makes Corrections for Aiming Post or Collimator Displacement

For details of correcting for aiming post or collimator displacement see paragraph 7-4.

Section IV. DUTIES OF ASSISTANT GUNNER CANNONEERS, AND DRIVER

5-22. Duties of the Assistant Gunner

a. Sets and lays for quadrant.

(1) The command is *QUADRANT ()*.

(2) Sets the announced quadrant on the elevation counter with the elevation knob.

(3) After the piece is loaded, elevates the tube until the elevation-level bubble is centered.

(4) Centers the cross-level bubble with the cross-level knob.

(5) Checks, and if necessary, recenters the elevation level bubble.

b. Calls "Set."

c. Depresses howitzer to loading elevation after each round is fired. Cleans obturator vent and primer seat as required.

Note. During lulls in firing, the assistant gunner and Number 1, swab out the bore, wash powder residue from the obturator head, the gas check seat, and the threaded section of the breech recess and breechblock.

5-23. Duties of No. 1 Cannoneer

a. Loads the howitzer.

(1) Places the projectile in the loading tray of the power rammer.

(2) At the command *QUADRANT ()*, moves rammer cylinder to ram position.

(3) Returns rammer to stowed position.

(4) Places the propellant charge in the chamber so that the red igniter pad is 3 inches inside the rear of the chamber (lashed end to the front); or in the groove on the bottom of the powder chamber on the M109A1.

(5) Commands *CLOSE* and closes breech.

(6) Inserts the primer into the primer chamber.

(7) Closes the block assembly. Slides the block assembly to the left to position the firing mechanism over the primer.

Note. The firing mechanism must be rotated into the desired firing position prior to loading.

b. Attaches the firing lanyard to the eyelet on the firing mechanism lever.

c. At the command of the chief of section, fires the howitzer with a quick strong pull on the lanyard.

d. Swabs and inspects the powder chamber forcing cone and obturator head, after each round is fired and calls "Bore clear." Calls out number and quadrant for each round when more than one round is fixed.

5-24. Duties of No. 2 Cannoneer

a. Fuzes projectiles.

(1) The command is *FUZE ()*.

(2) Removes lifting plug.

(3) Inspects fuze socket for rust or dirt.

(4) Removes or replaces supplementary charge as required.

(5) Screws in designated fuze, using authorized fuze wrench.

Caution: Do not hammer on a fuze wrench or use an extension handle.

(6) Removes safety pull wire from time fuzes.

b. With fuze setters M26, sets fuzes TSQ M501, TSQ M520.

(1) Seats upper lug of fuze setter in the upper recess of the fuze.

(2) Loosens wingnut on fuze setter, sets announced time on the appropriate time band.

(3) Locks wingnut, places handle to horizontal, turns counterclockwise until a stop is felt and a click is heard.

(4) Raises handle, removes setter, verifies setting.

c. With fuze setter M28, sets fuze VT M514 and fuze VT 728 series:

(1) Seats stationary lug of setter into top of recess of fuze.

(2) Sets announced fuze setting on the fuze setter.

(3) Turns setter clockwise until setter stops or a click is heard.

(4) Removes setter and verifies setting.

d. With fuze setter M63 or fuze wrench M34, sets fuzes M548, M564 and M565.

(1) Using fuze wrench or fuze setter, turn movable scale to announced whole second and align it with the 0 on the vernier (non-movable) scale.

(2) To set the tenths, line up the next line above and to the right of announced tenth on the vernier scale with the movable scale.

e. Sets selective superquick and delay fuzes.

(1) On fuze quick, verifies that letters S. Q. are alined with the slot on the setting sleeve.

(2) On fuze delay, turns setting sleeve with screwdriver until the slot is alined with word DELAY.

f. Combination time and superquick fuzes: For impact, the command is FUZE M501 (or other fuze) QUICK. Verifies that the letter "S" on the setting ring is alined with the index on the fixed ring.

Note. The wrench-type fuze setter M27 may be used to set the M501 and the M520 MTSQ fuzes. The setter is engaged in fuze notch and rotated in the direction of increasing readings, until the time setting is opposite the index mark on the fuze. This type of setter should be used only when mechanical setters are not available. See TM 9-2350-217-10 for appropriate fuze setters for available fuzes.

5-25. Duties of No. 3 Cannoneer

a. Inspects and cleans projectiles:

(1) Verifies that projectile is the type designated in the command.

(2) Removes grommet and examines rotating band to see that it is free from all dirt and burrs.

Note. Projectile with burred rotating band will be put aside until the burrs can be removed with a file.

(3) Examines entire projectile for defects.

(4) Stands projectile on end and cleans it thoroughly.

Note. Any sand, dirt, oil, or grease on the projectile will cause wear, scratches, or gouges in the bore.

b. Holds projectile upright for fuzing and fuze setting:

(1) Selects proper projectile as commanded.

(2) Holds projectile firmly while Number 2 fuzes and sets the fuze.

c. When directed, reads and announces the time set on the fuze.

d. Carries projectile to the howitzer.

(1) Grasps the fuzed end of the projectile with his left hand and the base with his right hand.

(2) Carries the projectile to the howitzer where it will be convenient for Number 1.

Caution: Care must be exercised in placing the

ammunition in the hull to prevent damage to the rotating band and fuze.

5-26. Duties of No. 4 Cannoneer

a. Prepares propellant charge, assisted by driver.

Note. Three types of charges are available for issue.

(1) Type M3A1 green bag, consisting of five charges, 1 to 5.

(2) Type M4A2 white bag, consisting of five charges, 3 to 7.

(3) Type M119 white bag charge 8 consists of one charge for use in M109A1 only.

b. The executive will designate the type of charge to be used.

(1) The command is LOT XY, CHARGE 3. The second code letter in the lot number indicates the type propellant, green bag or white bag, or which green bag or white bag lot if more than one is available. The charge number indicates how much propellant will be fired.

(2) Removes the complete charge, from the container, placing base charge on bottom. Propellant charges are not placed directly on the ground. Propellant operations should take place of the ammunition tarpaulin.

(3) Unties the lashings.

(4) Removes the bag marked "4" and "5".

(5) Ties remaining bags together.

(6) Removes igniter protector cap from base charge.

c. Hands propellant to driver and disposes of excess powder increments.

d. Green bag and white bag increments must not be mixed in the same charge. When additional flash reduction is desired, the flash reducer M2 can be used.

e. The M2 flash reducer is used with white bag propellants only.

f. Care and proper handling of ammunition must be insured. It is imperative that—

(1) There be no smoking in vicinity of ammunition.

(2) Only flashlights be used in vicinity of powder charges.

(3) Rough handling of projectiles, powder containers, fuzes, and primers be prevented.

(4) Projectiles do not strike together.

(5) Ammunition does not become dirty, wet, or overheated.

(6) When firing with charges 3 and 4, use of the M3 (green bag) propelling charge is preferred over the use of the M4A2 (white bag) propelling charge.

5-27. Duty of No. 5 Cannoneer.

Acts as section RTO.

5-28. Duties of Motor Carriage Driver

a. Assists Number 4 in preparing the propellant charge.

b. Hands the propellant charge to Number 1 so that he can grasp the base of the charge with his right hand.



CHAPTER 6

FIRING BY DIRECT LAYING

Section I. TECHNIQUE OF FIRE

6-1. General

a. Firing by direct laying is a special technique requiring a high standard of training. The section must operate as an independent unit. Training in direct laying is based on the technique involved in indirect laying. Targets taken under fire in direct laying are usually those capable of returning fire at pointblank range; therefore, speed and accuracy required in indirect laying become even more im-

portant for direct laying missions.

b. The *two-man, two-sight* system is normally used in laying for attack of a mobile target. However, if the elbow telescope is inoperable, the two-man, two-sight system must be modified by using the elevation quadrant to lay for elevation. This system is referred to as the *two-man, one-sight system*. In either case, the gunner continues to lay for direction by viewing the target through the

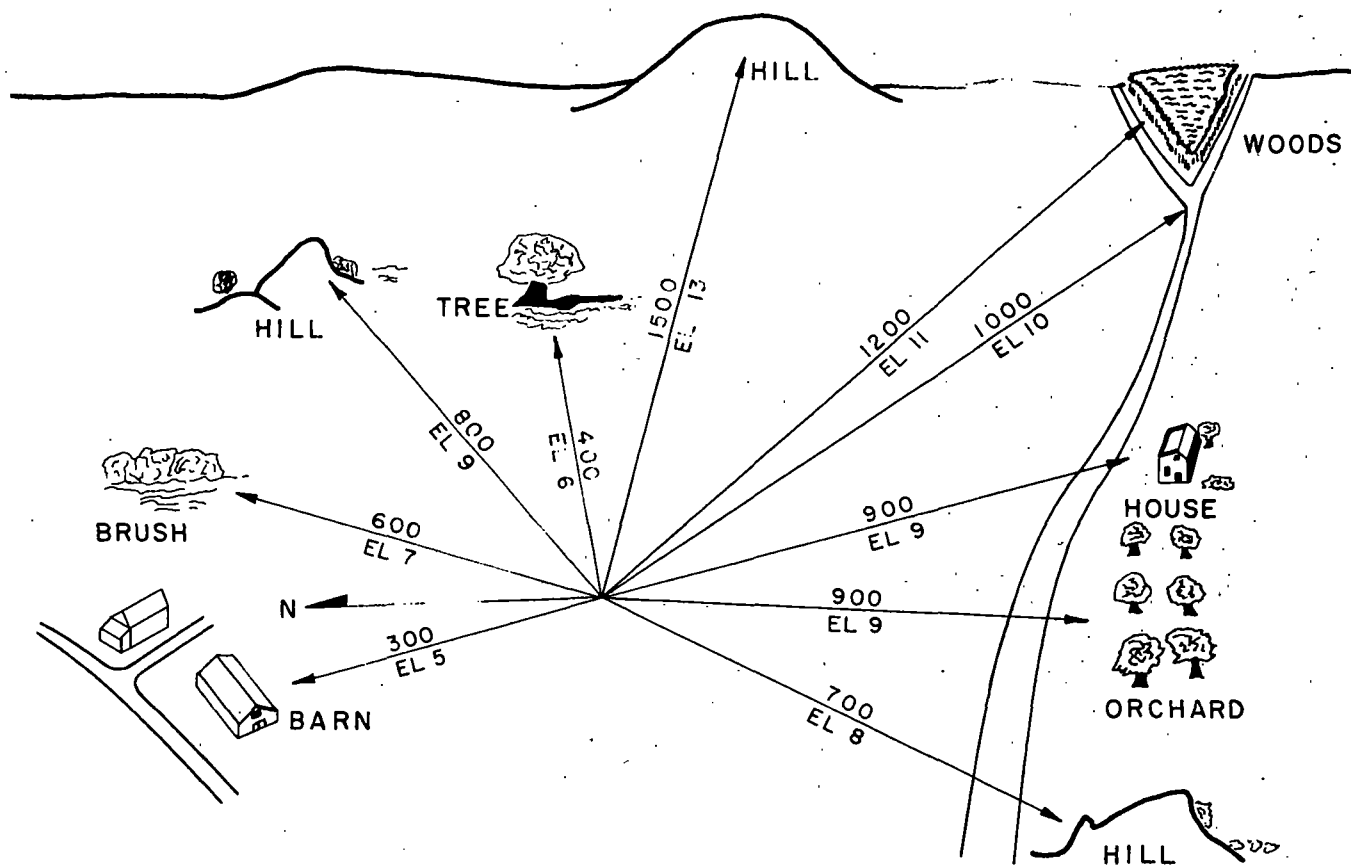


Figure 6-1. Range card for direct laying.

panoramic telescope. When the *one-man, one-sight* system is used, the gunner lays for lead and elevation with the panoramic telescope and the elevation counter of the telescope mount. This system is the least effective.

c. Stationary point targets, such as opening in permanent fortifications or cave openings, may be attacked by using either the indirect or direct laying methods. The indirect method is preferable. When the direct laying method is employed in attacking targets of this type, the service of the howitzer is as prescribed in *b* above.

6-2. Preparation of a Range Card

a. The chief of section is responsible for defense in his assigned sector, but he should be prepared to fire on targets in other sectors.

b. As soon as possible after occupation of position, the chief of section measures or estimates the ranges to critical points in likely avenues of approach for enemy tanks and vehicles and prepares a range card (fig 6-1) on which he notes the ranges and elevations for quick reference.

c. If there are no prominent terrain features, stakes may be driven into the ground at critical points for reference. As time permits, the range card is improved by replacing estimated ranges with more accurate ranges obtained by firing, pacing, taking, vehicle speedometer reading, map measurement, or survey.

d. The executive officer will assign numbers to certain prominent terrain features to facilitate target location. For example, the executive commands, *TARGET, TANKS, POINT NUMBER 2, FIRE AT WILL.*

e. As time permits, a deflection and a quadrant for each numbered point should be added to the range card to expedite and increase accuracy in firing. This is particularly critical for night operation.

6-3. Field of Fire

The sector of fire for the section should be cleared of all obstructions that might endanger battery personnel when the piece is fired or that might hinder observation. Care should be taken not to reveal the location of the position.

6-4. Targets

Targets for direct laying usually consist of vehicles, tanks, and personnel threatening the battery. Enemy personnel, whether alone or accompanying tanks, will seldom present themselves as a clearly defined target. Normally, attacking troops, using all available cover, reveal themselves only fleetingly. Accordingly, fire is conducted on the area containing the attackers rather than on the individuals. Tanks usually attack in groups and may be accompanied by

infantry. Normally, first priority is given to attack of those targets within the assigned sector of the weapon and second priority to targets in other sectors. Priority within the assigned zone is given to—

a. Tanks at short ranges, threatening to overrun the position.

b. Hull-down, stationary tanks covering the advance of other tanks.

c. The commander's tank, if identified.

d. The tank nearest cover, which may disappear and reappear at unexpected places.

e. The rear tank of a column moving across the front of the position, to minimize the possibility of attracting attention of the tank column to the battery position.

6-5. Ammunition and Fuzes

a. *General.* For close-in fires, a variety of fuzes are available (TM 9-1300-203). For high-explosive shell, the highest charge is used habitually for speed, ease in adjustment, imparting forward motion to fragments, and more effective fuze action. The flat trajectory resulting from the use of the highest charge coupled with dug-in guns may make extremely close-in firing impossible, since the projectiles may not detonate on impact. The terrain may be prepared for direct fire by placing mounds of sandbanks, dirt, or logs in the sector of responsibility. When direct fire is placed on these points or other previously selected points, as they are approached by an attacking force, the necessity for adjusting fire is reduced.

b. *Ammunition.* Only high-explosive (HE) ammunition is used against type targets as mentioned in paragraph 6-1. Shell, HE, is ideally suited for antipersonnel fire and is effective against vehicles and tanks.

c. *Fuzes.* High explosive shells may be fuzed with fuzes quick, delay, time, or concrete piercing. Fuze quick is the most desirable fuze to use with HE shell for close-in fires. It is highly effective and, since no fuze setting is required, is much faster to use. The time required to set the fuze and to adjust the point of impact for maximum ricochet effect makes fuze delay less desirable than fuze quick. If fuze delay is used for ricochet effect, the point of impact is adjusted 10 to 30 meters short of the target; if less than 50 percent are ricochet bursts, fuze quick should be used. Fuze time is the least desirable type of fuze for close-in fires. Because of the wide range dispersion resulting from variations in time of burning with short fuze settings, fuze time should be used only for ranges greater than 1,000 meters. The area covered effectively by air and ricochet burst are similar. Concrete piercing fuze with shell HE should be used against concrete pillboxes or fortification.

6-6. Trajectory Characteristics

Trajectory characteristics for different ranges must be considered prior to engaging targets under direct fire. The trajectory characteristics in table 6-1

provide data for the effective direct fire ranges of the M109 and M109A1 howitzers. Direct fire data for charge 8 (M109A1) will be provided when developed and available.

Table 6-1. Direct Fire Table, 155mm Howitzer, M109, SHELL HE, Charge 7

Range meters	Elevation mils	Vertical displacement feet	Trajectory characteristics	Firing data
100	2	.0	Within these ranges the trajectory is flat enough to prevent an 8-foot tank from passing safely beneath it. Fields of fire and terrain allowing the upper range limit is ideal at which to open fire. This allows maximum time for conduct of fire. Range shifts of 100 meters are usually sufficient to bring the rounds on target.	1. Start firing at estimated range or 400 meters, whichever is greater. 2. Make 100 meter range changes until the round is brought on target.
200	3	.5		
300	5	1.0		
400	6	1.5		
500	8	2.0		
600	10	3.0		
700	12	3.5	Within these range limits it is necessary to establish a bracket. This is necessary due to the flat trajectory and the difficulty in estimating the correct range change in meters necessary to place rounds on target. A round that misses the target due to height of trajectory will land behind the target in range. Bracketing enables a more rapid adjustment on target. Range shifts of 200 meters should be made until a bracket is obtained.	1. Start firing at the estimated range. 2. Adjustment with the use of a bracket (overs and shorts) is required. 3. Make 200 meter range changes until a bracket is established. 4. Split the bracket until a target hit is obtained.
800	13	4.0		
900	15	4.5		
1000	17	5.0		
1100	19	6.0		
1200	20	6.5		
1300	22	7.0		
1400	24	8.0		
1500	26	8.5	Within these ranges a hit on a moving target must be considered only reasonably possible. A bracket should be established using 400 meter range changes. Firing should be done at these ranges only when surprise is not important.	1. Start firing at the estimated range. 2. Adjustment with the use of a bracket (overs and shorts) is required. 3. Make 100 meter range changes until a bracket is established. 4. Split the bracket until a target hit is obtained.
1600	28	9.5		
1700	30	10.0		
1800	32	10.5		
1900	34	11.5		
2000	36	12.0	At ranges greater than 2200 meters, direct laying is not advisable against moving targets. Increasing angle of fall of the projectile, difficulties in range estimation and the size of the target in the sight combine to make a target hit difficult and unlikely.	
2100	38	13.0		
2200	40	13.5		

Section II. DUTIES OF THE SECTION: TWO-MAN, TWO-SIGHT SYSTEM

6-7. List of Duties Chief of Section

a. *Conducts the Fire of His Piece.* The chief of section conducts the fire of his piece when the executive commands **TARGET** (so-and-so), **FIRE AT WILL**, or simply **FIRE AT WILL**. Alerts section to prepare for direct fire.

b. *Identifies or Selects the Target.* If the executive designates an object or one of a group of objects as the target, the chief of section must correctly identify the target. If the target is a group of tanks or other objects, the chief of section selects the one

that, in his estimation, is the greatest threat to his own position or the position of the supported troops. He repeats the identification to his section, using the minimum number of words, such as **LEAD TANK** or **MOVING TANK**. Takes post where he can best see the effect on the target prior to engaging direct fire targets. Priorities are—

(1) Tanks at short range threatening to overrun the position.

(2) Hull down stationary tanks covering the advance of other tanks.

(3) Area containing personnel threatening to overrun the position.

c. *Estimates the Range to the Target.* Range cards (fig 6-1) with accurately measured ranges to key points provides the best means for determining the initial range. If a range card has not been prepared,

the range is estimated. Estimated ranges are used if accurate measurements are not available.

d. *Determines the Lead in Mils.* The approximate lead in mils for targets moving at various speeds for firing with the maximum charge is shown in table 6-2.

Table 6-2. Determination of Leads

Speed (MPH)		Lead (mils)	
		Target traveling perpendicular to line of fire	Target traveling 45° to line of fire
Slow	5	5	5
	10	10	5
	15	15	10
Medium	20	20	15
	25	20	15
Fast	30	30	20

e. Gives Initial Commands. The chief of section gives fire commands containing the following elements in sequence:

(1) *Designation of Target.* The command is **TARGET** (so-and-so). Identification must be clear and unmistakable and should be expressed in the minimum number of words.

(2) *Projectile, Charge, and Fuze.* The chief of section selects the appropriate projectile, charge, and fuze and commands **SHELL ***, **CHARGE ***, and **FUZE ***.

(3) *Lead.* The command is **LEAD** (so much).

(4) *Method of Fire.* Fire is continuous unless otherwise commanded. In continuous fire, the piece is loaded and laid as rapidly as possible and fired at the command of the gunner.

(5) *Range or Quadrant.* The command is **RANGE** (so much) or **QUADRANT** (so much). The range announced by the chief of section is that range to be set on the sight reticle of the direct fire telescope. If the *two-man, one-sight* system is to be used, the chief of section announces the range element of the command as quadrant. The announced Quadrant is applied as indicated above.

(6) Example.

Sequence	Element	Example
1	Target designation	TARGET (tank)
2	* Projectile, charge and fuze	SHELL HE, CHARGE 7, FUZE QUICK OR SHELL HE, CHARGE 7, FUZE DELAY.
3	Lead	LEAD, RIGHT (LEFT) 10
4	Method of fire	Fire is continuous unless otherwise commanded.
5	Range	RANGE 600

f. Gives Subsequent Commands Based on Observed Effect.

(1) The chief of section gives the following commands based on observed effect:

(a) *Change in lead.* During adjustment the lead in mils is changed to a new lead command incorporating total lead.

(b) *Change in range.* During adjustment the range is increased by the command **ADD** (so much) and is decreased by the command **DROP** (so much). When *two-man, one-sight* systems or

one-man, one-sight system is used, the commands are **UP** (so much).

(2) After the breechblock is closed, the chief of section gives further changes in firing data based on movement of the target during the time required for loading.

6-8. List of Duties, Gunner

a. *Duties of the Gunner, Reticle Laying.* Having received the fire command from the chief of section, the gunner performs the following duties:

*As appropriate.

(1) Insures that the cross-level bubble is centered, the azimuth counter is set at 3200, and the gunner's aid (counter) index is at zero.

(2) Actuates the click sight mechanism and centers the pitch and cross level bubbles.

(3) Establishes the lead announced by the chief of section by sighting through the panoramic telescope and traversing the tube until the target appears in the proper relationship to the vertical crosshair of the sight reticle (fig 6-2). When the announced lead has been established the gunner continues to track the target by traversing the tube.

(4) When the assistant gunner calls "SET" indicating that the tube has been laid for range and when, at the same time, the proper lead has been established, the gunner commands FIRE.

(5) After firing, the gunner continues to track and fire on the target until it is destroyed or until a subsequent fire command is issued by the chief of section.

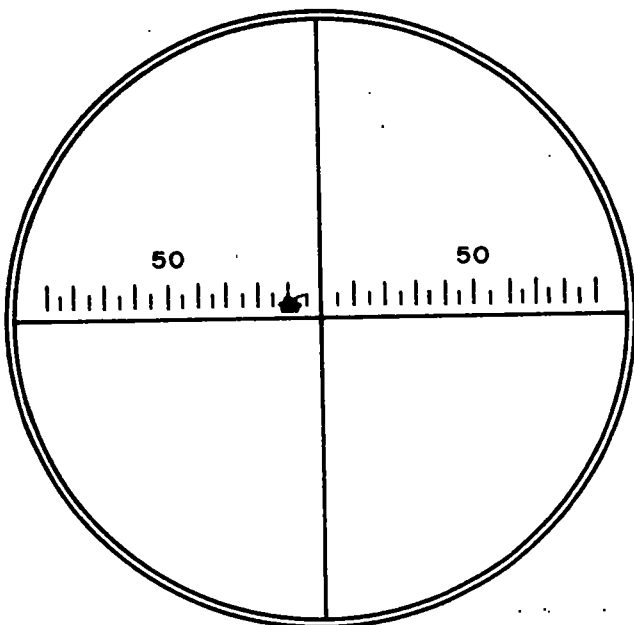


Figure 6-2. Gunner's sight picture, reticle laying, lead 10 mils.

b. Duties of the Gunner, Central Laying. The gunner—

(1) Centers the cross-level bubble on the panoramic telescope mount, zeroes the gunner's aid counter, and sets 3,200 on the azimuth counter.

(2) Places the announced lead on the azimuth counter.

(3) Traverses the tube until the vertical reticle of the panoramic telescope is on the center of the target. Subsequent changes in lead are made in 5-mil increments by sound (clicks) and feel when turning the azimuth knob.

(4) Continues to track the target by traversing the tube maintaining the vertical reticle in the center of the target.

(5) Commands *FIRE* after the assistant gunner calls "SET," indicating that the tube has been laid for range, and at the same time the vertical line is directly on the target.

(6) When the chief of section commands *RIGHT (LEFT) ()*—

(a) Turns Azimuth knob in 5-mil increments to set the lead change as directed.

Note With the click sights, the gunner can determine by sound and feel when the appropriate change has been made without moving his eye from the telescope eyepiece.

(b) Traverses the piece until the vertical reticle is again centered on the mass of the target.

(c) Checks that the pitch- and cross-level bubbles are centered.

(d) Commands *FIRE*, after the assistant gunner has called Set.

6-9. Duties of Assistant Gunner—Reticle and Center Laying

Having received the fire command, the assistant gunner performs the following duties:

a. Insure the cross-level bubble is centered, the elevation counter dial is set at zero, and the appropriate setting is on the correction indicator dial.

b. Lays the piece for range (elevation) by sighting through the direct fire telescope and by elevating or depressing the tube until the target appears in the proper relationship to the range lines of the telescope reticle (fig 6-3).

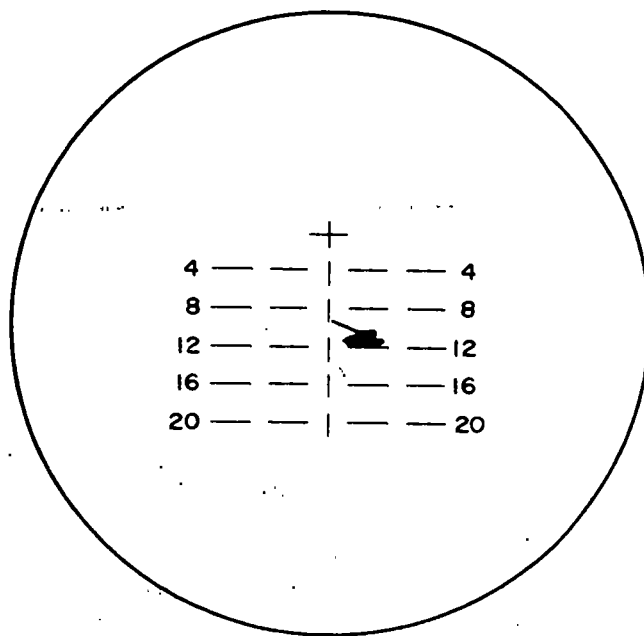


Figure 6-3. Assistant gunner's sight picture, direct fire telescope, range 1,200 meters, lead 5 mils.

c. Checks the level-vial mirror and adjusts for *CANT*, as required, to center the bubble. A canted reticle in the direct fire telescope introduces an unacceptable range error and prevents satisfactory direct fire on moving targets.

d. When the piece has been laid for range, the assistant gunner calls "Set." He continues to call "Set" as long as he is laid on the target.

e. When the chief of section commands *ADD (DROP)* ()--

(1) Elevates or depresses the piece until the appropriate range line is centered on the mass of the target.

(2) Checks the level-vial mirror and adjusts for cant as required.

(3) Calls "Set."

Note. During the laying sequence, checks the direction of the lead as set by the gunner.

6-10. Duties of Cannoneers and Driver

a. Cannoneers perform the same duties in firing by direct laying as those prescribed for firing by indirect laying. No. 1 receives the command to fire from the gunner.

b. The driver of the motor carriage takes his post in the driver's compartment, starts the engine, and prepares to shift the vehicle as directed.

Section III. DUTIES OF THE SECTION: ONE-MAN, ONE-SIGHT SYSTEM

6-11. Duties of the CHIEF of Section

a. In addition to the duties outlined in paragraph 6-7, the chief of section announces quadrant in his fire command rather than range.

b. *Conversion of Range to Quadrant.* The chief of section should use table 6-1 for converting range to quadrant. When any method of fire other than the *two-man, two-sight* system is used, the chief of section converts the estimated range to miles and announces this value to his fire command as *QUADRANT* (so much). Subsequent commands for range changes are converted to quadrant and expressed as *ADD (DROP)* ().

6-12. Duties of the Gunner

In the one-man, one-sight system, the piece is laid for both deflection and elevation by the gunner. The gunner sets the announced quadrant on the elevation

counter dial and insures that the appropriate setting is on the elevation correction indicator dial. He then elevates or depresses the tube until the elevation level bubble is centered and centers the cross-level bubble. With 3200 set on the azimuth counter dial and the gunners aid index at zero, he then traverses the tube until the vertical crosshair of the telescope reticle is on the target or the proper lead is established. When the tube has been laid, the gunner commands *FIRE*. After firing, he continues to lay on the target until it is destroyed, or a subsequent fire command is given by the chief of section.

6-13. Duties of the Cannoneers and Driver

With the exception of the assistant gunner, the section performs the same duties as outlined in paragraph 6-10. The assistant gunner is assigned duties by the chief of section.

Section IV. DUTIES OF THE SECTION: TWO-MAN ONE-SIGHT

6-14. Chief of Section

The chief of section performs the same duties as outlined in paragraphs 6-7 and 6-11.

6-15. Gunner

The gunner performs the same duties as outlined in paragraph 6-12.

6-16. Assistant Gunner

When the two-man one-sight system is used, the

assistant gunner sets the announced quadrant on the quadrant elevation counter dial. He also insures that the right setting is on the correction indicator dial. He elevates or depresses the tube until the elevation level bubble is centered, then he calls "*SET*."

6-17. Cannoneers and Driver

The remainder of the section performs those duties outlined in paragraph 6-10.

CHAPTER 7

TECHNIQUES AND SITUATIONS REQUIRING SPECIAL ATTENTION

Section I. GENERAL

7-1. Precision in Laying

a. Sighting and laying instruments, fuze setters, and elevating and traversing mechanisms must be properly operated in a manner which will reduce the effects of lost motion. For uniformity and accuracy, the last motion is setting the instruments must be from lower to higher numbers final motion of the elevating handcrank must be in the direction of more difficult movement, and final motion in traversing must be from left to right.

b. When a bubble is centered, the line of sight must be at a right angle to the scale or level vial to prevent parallax errors. Bubbles must be centered exactly.

c. For uniformity and accuracy in laying on aiming posts or the collimator, the vertical crosshair in the reticle of the panoramic telescope must be alined with the left edges of the aiming posts, or the center line of the collimator.

7-2. Aiming Points

a. *General.* After the piece has been laid initially for direction, it is referred to the aiming posts or collimator and usually to one or more distant aiming points as described below. An aiming point must have a sharply defined point or vertical line which is clearly visible from the piece, so that the crosshairs of the panoramic telescope can be alined on exactly the same place each time the piece is relaid.

b. *Distant Aiming Point.* A distant aiming point is one at sufficient distance so that normal displacements of the piece in firing or traverse will not cause a horizontal angular change in direction (with the same setting on the azimuth counters) of more than one-half mil. This distance should be at least 1,500 meters. The executive officer usually designates the distant aiming point or points to be used.

Section II. USE OF AIMING POSTS OR THE INFINITY
AIMING REFERENCE COLLIMATOR M1

7-3. Aiming Posts

a. Two aiming posts are used for each piece. Each aiming post is equipped with a night lighting device for use at night. The most desirable distance from the piece to the far aiming post is 100 meters, considering accuracy of laying, visibility, and ability to control the aiming post night lighting devices. First, the far aiming post is set up and alined. The near aiming post is then set up at the midpoint between the far aiming post and the panoramic telescope and is alined by the gunner so that the vertical crosshair of the telescope and the left edge of the two aiming posts are in alinement. To insure equal spacing of aiming posts, the distances to both the near and far aiming posts should be paced by the same man. If ground conditions make spacing inaccurate, the distances from the piece to the aiming posts may be measured by using the panoramic telescope, with the aiming posts as measuring devices (*d* below).

b. For night use, the aiming post night lighting devices should be adjusted so that the far night

lighting device will appear above the near device. On flat terrain this may be accomplished by using only the lower half of the near aiming post. The two night lighting devices placed in this manner will establish a vertical line for laying the piece.

c. Since the panoramic telescope is mounted at considerable distance from the center of rotation of the top carriage, large changes in deflection will cause misalinement of the aiming posts. Placing the aiming posts to the left front when the piece is in the center of traverse will keep this misalinement to a minimum and still allow maximum visibility.

d. To measure the distance from the piece to the aiming posts, the stadia method may be employed by using the panoramic telescope and the aiming posts as measuring devices. Number 4 cannoneer, in setting out the aiming posts, holds the upper section of one of the aiming posts in a horizontal position, perpendicular to the line of sighting. The gunner measures the length of this section in mils using the reticle of the panoramic telescope. For example the upper section of the aiming post is 4½ feet long and

measures 14 mils when it is 100 meters from the piece. The proper location for the near aiming post, in this case, would be the point at which the 4½ foot section measures 28 mils. In many cases, the ideal spacing of 50 and 100 meters cannot be obtained, but the aiming posts will be properly spaced when the near aiming post is set at a point where the 4½ foot section measures twice the number of mils if measured at the far aiming post location. This measurement may be performed at night by attaching the night lighting devices at the 4½ foot marks on the aiming posts.

7-4. Infinity Aiming Reference Collimator M1A

The collimator (fig 5-1) is an optical instrument intended to be used for indirect laying of field artillery weapons by establishing an optical reference from which weapon deflection angles can be measured.

a. The mounting base is a mechanical assembly consisting of a tripod and yoke subassembly which houses the azimuth and elevation controls. The tripod supports the collimator at a normal height of 3 feet above the ground and is leveled by extending or retracting the hinged tripod legs. The azimuth clamping knob directly below the yoke is used to clamp the azimuth mechanism. The elevation yoke allows the collimator to be adjusted plus or minus 48° in the vertical plane. The elevation clamping knob located near the top of the yoke is used to operate the elevation clamping mechanism.

b. The collimator assembly consists of an optical system, a mechanical housing, and a light source. The reticle pattern is essentially an azimuth reference scale repeated at vertical intervals to form a grid throughout the collimator field of view. The reticle pattern may be cross-leveled by rotating the entire collimator assembly about the optical axis. A cylindrical cross-level vial attached to the collimator serves as a reference in cross-leveling. A cross-level clamping knob near the center of the collimator permits rotation of the collimator for cross-leveling and locks the collimator in place after it has been cross-leveled. Open sights on the collimator assembly permit rapid alinement of the optical system with the panoramic telescope sight of the weapon.

c. When the collimator is used with self-propelled weapons, DC power is provided by the electrical system of the vehicle. A wirewound series resistor within the junction box reduces the voltage so that the 12-volt lamp of the collimator may be safely operated from the 24/28-volt electrical system of the vehicle. The remote control unit contains a PUSH-TO-USE switch for turning the reticle illumination ON or OFF and a rheostat for regulating the intensity of the light.

d. The collimator optics are protected when not in use by a cover made from fiberglass-reinforced plastic. The cover is equipped with a carry handle and is attached to the collimator by three snap-latches. A strap restrains the tripod legs when they are folded.

7-5. Operation of Collimator

a. The infinity aiming reference collimator M1 is basically an optical instrument used in indirect fire by field artillery weapons. It is intended to replace the M1-series aiming posts as a reference from which deflection angles may be measured. After the weapon has been laid for direction, the collimator may be positioned 4 to 17 meters to the left front of the panoramic telescope sight at a deflection established by unit SOP. Best results are obtained from 5 to 12 meters.

b. Preparation for Use.

(1) Setting up the collimator.

(a) Loosen the strap on the instrument cover assembly and open the latches between the cover end and the collimator base. Depress the tripod legs, then open the latches and remove the cover.

(b) Set the tripod legs into the ground as level and firmly as possible consistent with the situation and the time available. Precise leveling is not necessary since the reticle can be cross-leveled separately.

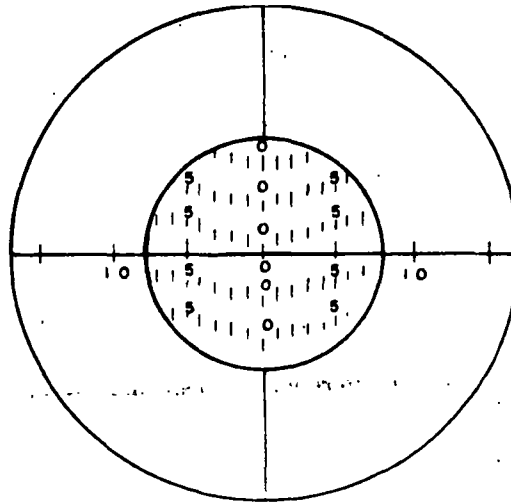
(c) Loosen the azimuth and elevation clamping knobs. Move the collimator, while sighting through the front and rear sights, until the optical system is sighted on the panoramic sight of the weapon.

(d) Release the collimator clamping knob. Refer to the cylindrical cross-level vial located on the collimator, rotate the collimator until the bubble is centered. The reticle pattern is then cross-leveled.

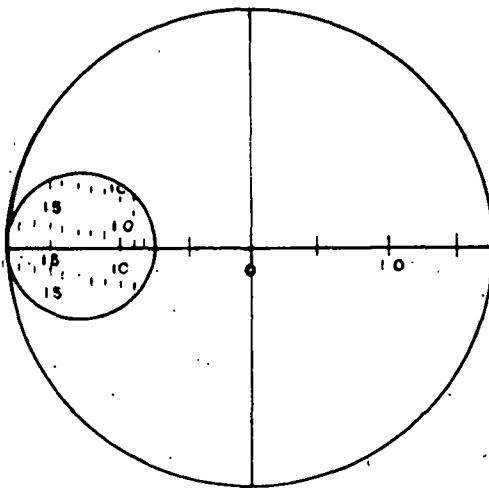
(2) Laying and referring. After the collimator has been set up and alined with the panoramic telescope of the weapon, the gunner's sight picture should appear as shown in initial alinement (fig 7-1) provided there is no displacement. For accurate laying and referring, the gunner should be able to see at least a 7-mil diameter area or two significant numbers on the reticle pattern. He is normally able to see an area of this size when the collimator is between 5 and 12 meters from the weapon. The numbers shown in the reticle pattern indicate angles of 5-mil increments. Individual mils are marked by short vertical lines in the V-format of the pattern. The V-format of the pattern indicates left and right displacement of the weapon even when a small portion of the reticle pattern is visible. To correct for piece displacement, the gunner sights on the collimator and matches the reticle of the panoramic telescope with the collimator reticle

pattern. For example, if the gunner sees 10 and 15 in the collimator and the reticle slopes upward from right to left, which indicates right displacement, he

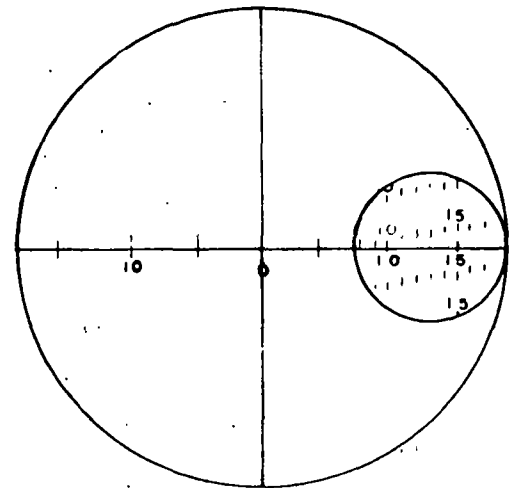
matches the left portion of the panoramic telescope reticle with the collimator reticle pattern as shown in right and left displacement positions in figure 7-1.



INITIAL ALINEMENT



RIGHT DISPLACEMENT



LEFT DISPLACEMENT

Figure 7-1. Gunner's sight picture of collimator when correcting for displacement.

7-6. Care and Handling

a. Stops on the instrument limit the travel of the collimator in elevation or depression. The operator should not attempt to force the collimator beyond the stop limits.

b. The collimator should be covered and protected from dust and moisture when it is not in use.

c. The collimator assembly should not be pointed directly at the sun unless a filter is used; the heat from the focused rays may damage the optical elements.

d. All exposed surfaces must be kept clean and dry to prevent corrosion and/or etching of the optical elements.

e. Instrument knobs should not be forced beyond their limit of motion.

7-7. Correction for Displacement of Aiming Posts

When the gunner notes that the vertical crosshair of the telescope is displaced from the line formed by the two aiming post (or aiming post lights). He lays the piece so that the far aiming post (light) appears exactly midway between the near aiming post (light) and the vertical crosshair (fig 7-2). If the displacement is due to traversing the piece, the gunner continues to lay as described above. If the displacement is due to progressive shifting of the carriage caused by the shock of firing, or other cause, the gunner will notify the chief of section, who, at the first lull in firing, will notify the executive and request permission to realine the aiming posts. To realine the aiming posts, the piece is laid with the far aiming post midway between the near aiming post and the vertical crosshair (fig 7-2). The far aiming post is moved into alinement with the vertical crosshair of the scope and then the near aiming post is alined. If terrain conditions make it impracticable to move one of the two aiming posts, the piece is laid for direction and referred to the aiming post that cannot be moved. The other post is alined by using the method described in paragraph 5-

22, and the azimuth reset counter is turned to 3200.

7-8. Correction for Displacement of Collimator

In case of weapon displacement during firing, the gunner simply traverses the howitzer until reticle match is again obtained, and the howitzer is alined parallel to its original orientation (para 7-5b(2) and fig 7-1).

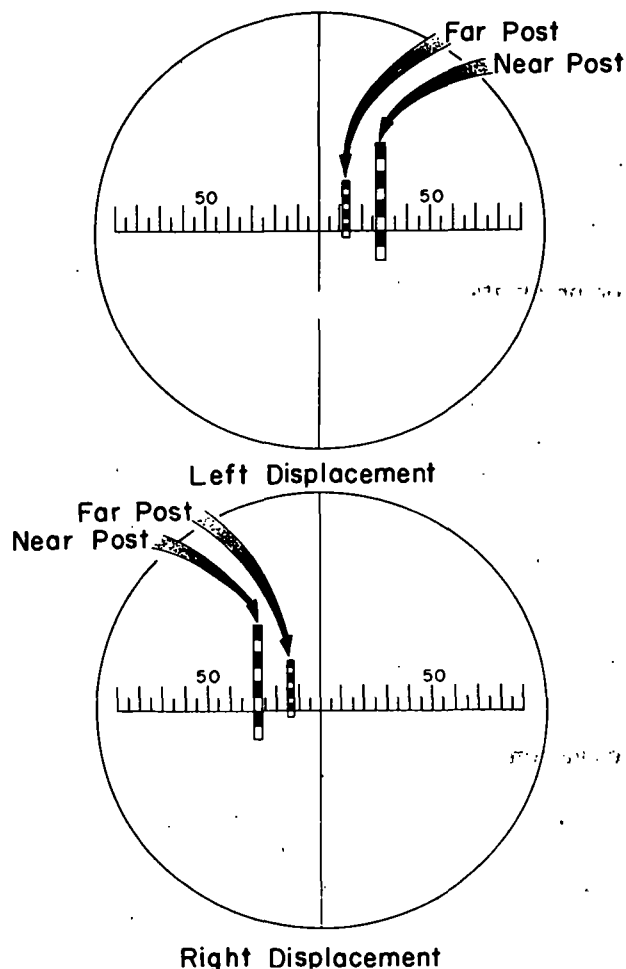


Figure 7-2. Gunner's sight picture of aiming posts in proper relationship when correcting for displacement.

Section III. SPECIAL OPERATIONS

7-9. Check Firing

The command CHECK FIRING is normally given to the section by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of its source, firing ceases immediately. If the piece is loaded, the chief of section reports that fact to the executive. The executive acknowledges this announcement by saying "number (so-and-so) loaded." If CHECK FIRING is commanded by the fire direction center, firing is resumed at the announcement of CANCEL

CHECK FIRING and QUADRANT. If CHECK FIRING is commanded from within the firing battery, the executive investigates the condition that caused the command to be given. When the condition is corrected, firing is resumed at the executive's command of CANCEL CHECK FIRING QUADRANT (so much).

7-10. Changes in Data During Firing

If it is necessary to correct any element of firing data, all firing previously ordered but not yet

executed is stopped by the command CHECK FIRING. Corrected data is then announced. If the piece is not loaded, the new data is set off and firing is resumed at the command CANCEL CHECK FIRING QUADRANT (so much). If the piece is loaded and no change in the fuze setting is required or if the piece is loaded with a percussion-fuzed projectile, the new data is set off and firing is resumed at the command CANCEL CHECK FIRING QUADRANT (so much). If the piece is loaded with time-fuzed projectile and a change is required in the fuze setting, the chief of section suspends firing and reports that fact to the executive; for example, "No. 2 loaded, time (so much)." The piece will not be unloaded unless directed by the executive. In continuous fire, changes in data are so applied as not to stop the fire or break its continuity.

7-11. To Unload the Piece

A complete round, once loaded, should always be fired in preference to being unloaded unless military necessity dictates otherwise. The piece will be unloaded only on specific order and under the direct supervision of an officer. To unload the howitzer, the command is UNLOAD, and the operation is performed as follows:

a. No. 1 cannoneer slides the block assembly to the right and removes the primer, *being careful not to strike the primer against any metallic surface causing it to ignite.*

b. The assistant gunner depresses the tube to zero elevation.

c. No. 1 cannoneer opens the breechblock, removes the propellant from the chamber, and then fills the powder chamber with rags or other waste materiel, and then closes the breechblock.

d. No. 3 and No. 4 cannoneers insert the unloading rammer into the muzzle end of the tube and pushes carefully until the rammer head encircles the fuze and is seated against the projectile. Steadily increasing pressure is applied by hitting the end of the rammer staff with a wooden block, if necessary, to loosen the projectile.

e. When the projectile is loosened, No. 3 and No. 4 cannoneers suspend operation of the rammer while the chief of section has the breech opened by the assistant gunner and the waste removed by No. 1 cannoneer, who then places the loading tray in position to receive the projectile.

f. Numbers 3 and 4 cannoneers steadily push the projectile out of the breech and on to the loading tray.

g. The projectile is then disposed of as directed by the chief of section.

Warning: Unloaded projectiles and fuzes are not reloaded and fired. Put these aside and turn in to EOD.

7-12. Care of Ammunition

a. To insure uniform results in firing, to prolong the life of the tube, and to avoid accidents, care must be exercised in the storage and handling of ammunition at the battery. Provisions of TM 9-1300-200 and TM 9-1300-203 applicable to field service should be followed carefully. In the field, conditions existing in each position will determine the amount of time, labor, and materials required to store and preserve the ammunition adequately. If the position is to be occupied for only a few hours, a tarpaulin spread on the ground may be sufficient; for longer periods of time, more elaborate facilities should be provided.

b. Ammunition must be protected from damage. When projectiles are received, they should be sorted into lots and placed in the best available storage. Ammunition data cards should be kept until all ammunition for that lot is expended. The eyebolt lifting plug should not be removed from unfuzed projectiles until the fuze is to be inserted. Protection should be provided against moisture, dirt, direct rays of the sun and, as far as practicable, field artillery fire and bombing. Protection against weather, dirt, and the sun may be obtained by the use of tarpaulin and dunnage. Projectiles stacked in the open should be raised at least 6 inches off the ground. If drainage is not good, ditches should be dug around the stacks. A liberal use of dunnage should be made between layers, and covering tarpaulins should be raised at least 6 inches from the stack to insure adequate ventilation. Ammunition should be stacked in no more than three layers high with no more than fifty rounds in each layer. Stacks should be at least ten meters apart.

c. Powder charges should be sorted into lots and protected from sources of high temperatures, including direct rays of the sun. More uniform firing is obtained if the charges are of the same temperature. Powder charges should not be removed from containers until just before firing.

d. Explosive elements in primers and fuzes are particularly sensitive to shock and high temperature; therefore, strict attention should be given to their care and handling. Protection and safety devices should not be removed from fuzes until just before use. No attempt should ever be made to disassemble a fuze into its components.

7-9. Section Data Board

When a position is occupied for more than a few hours, data boards may be used by each section to

record such items as deflections to aiming points, calibration corrections when appropriate, minimum elevations, data for the final protective fires and counter-preparations, and other data which may be needed quickly. If such information assumes a

standard pattern, the section may paint a form on a convenient part of the weapon and chalk in the various items of information in the appropriate spaces.

Section IV. AMPHIBIOUS OPERATIONS

7-13. General

The howitzer can be equipped with a flotation device which will enable it to navigate rivers, lakes and other water obstacles. The flotation device consists of four bag-retainer assemblies to be installed on the sides and on the front of the vehicle, water barriers for each forward side and across the front of the vehicle to reduce water seepage to the power compartment, and auxiliary equipment such as valves, blowers, hoses and fittings necessary to inflate the bags.

7-14. Preparation

To prepare the howitzer for amphibious operations requires six crewmen for approximately 60 minutes if the kit is to be installed. If the kit has previously been installed, approximately 6 minutes will be required to inflate the bags before entering the water and approximately 35 minutes to remove the kits, using six crewmen, after leaving the water. Duties are as listed in paragraphs 7-15 through 7-23.

7-15. Duties of the Chief of Section

a. Commands PREPARE FOR AMPHIBIOUS OPERATION. Supervises the section during the operation.

Note. The duties performed by numbers 3, 4, and 5 will have to be accomplished by the remaining section members in the event the ammunition vehicle is not present.

b. Verifies that the howitzer is prepared for amphibious operation. Insures that all personnel are wearing life preservers.

c. Commands the operator to enter the water.

7-16. Duties of the Gunner

a. Engages cab traverse lock. Elevates tube to allow installation of barriers. Removes air inlet cover. Installs front bag.

b. Insures that cab and hull are securely closed.

7-17. Duties of the Assistant Gunner

Assists gunner to install front bag.

7-18. Duties of No. 1 Cannoneer

a. Installs barriers.

b. Attaches bilge pump hose to hull outlet.

7-19. Duties of No. 2 Cannoneer

a. Assists No. 1 to install barriers.

b. Removes window cover from barrier.

7-20. Duties of No. 3 Cannoneer

a. Releases side bag latches on the left side of the howitzer.

b. Verifies that bag supports on the left side are engaged.

7-21. Duties of No. 4 Cannoneer

a. Releases side bag latches on the right side of the howitzer.

b. Verifies that bag supports on the right side are engaged.

7-22. Duties of No. 5 Cannoneer

Assists No. 1 to install barriers.

7-23. Duties of Motor Carriage Driver

a. Lowers and secures howitzer traveling lock. Installs muzzle plug. Removes engine exhaust deflector. Verifies battery cell vent caps are tight.

Warning: Injury may occur to feet if travel lock is allowed to fall back on deck.

b. Opens and secures dipstick cover with spring retainer. Closes hull drain plugs. Closes personnel air duct.

c. Places inflation-deflation lever to the inflate position, turns on blower switch and inflates the flotation bags. Shifts transmission lever to "2" range and starts bilge pump.

d. At the command of the chief of section, enters the water slowly at right angles to the bank.

7-24. After Operation

Duties of the section in Amphibious Operations are listed in paragraphs 7-25 through 7-33.

7-25. Duties of Chief of Section

a. Supervises the section during the operation.

b. Inspects the vehicle to insure that the flotation device is secure.

c. Reports "Sir, No. () in order," or any defects the section cannot remedy without delay.

7-26. Duties of the Gunner

a. Removes front bag and replaces air inlet cover.

b. Depresses the tube.

7-27. Duties of the Assistant Gunner

Assists gunner to remove front bag.

7-28. Duties of No. 1 Cannoneer

- a. Removes bilge pump hose from hull outlet.
- b. Removes and secures barriers.

7-29. Duties of No. 2 Cannoneer

- a. Replaces window cover on the barrier.
- b. Assists No. 1 to remove barriers.

7-30. Duties of No. 3 Cannoneer

Assists No. 1 to remove and secure barriers.

7-31. Duties of No. 4 Cannoneer

Assists No. 1 to remove and secure barriers.

7-32. Duties of No. 5 Cannoneer

Assists No. 1 to remove and secure barriers.

7-33. Duties of Motor Carriage Driver

- a. Approaches bank slowly at a right angle and reduces track speed. Drives vehicle to level ground. Opens drain valve in the driver's compartment. Operates bilge pump until all water is drained from the engine compartment. Deflates flotation bags.
- b. Close dip stick cover. Replaces engine exhaust deflector.
- c. Raises and secures howitzer travel lock. Checks transmission and final drive oil levels for water contamination.



CHAPTER 8

BORESIGHTING

Section I. GENERAL

8-1. Description

a. Boresighting is the process of verifying that the optical axis of the on-carriage fire control equipment is parallel with the axis of the tube of the weapon both for deflection and for elevation. Any misalignment discovered through boresighting is corrected as described below. The tube should be placed near its center of traverse prior to boresighting. All instruments and mounts must be positioned securely and there must be no free play. Boresighting is conducted before firing, during lulls in firing, and when the howitzer fires inaccurately for no apparent reason.

b. There are three methods of boresighting these weapons.

- (1) Testing target method (para 8-5-8-8).
- (2) Distant aiming point method (para 8-9).
- (3) Aiming circle method (para 8-10).

8-2. Equipment

The following equipment is needed for boresighting:

a. *Boresights*. Front and rear boresights or improvised substitutes are necessary. If boresights are not available, crosshairs may be fastened on the muzzle, and the obturator spindle vent may be used as a rear sighting guide.

b. *Testing Target*. A testing target (fig 8-1) or suitable substitute is needed for preparatory steps in testing and for certain methods of boresighting. If a testing target is not available, a clearly defined aiming point 1,500 or more meters from the piece may be used to accomplish approximately the same purpose as the testing target.

(1) The target should be mounted on a flat piece of masonite, wallboard, or similar material.

(2) To insure stability of the testing target

throughout boresighting, it should be fastened securely to a stand.

(3) For use in either leveling or canting the testing target, a mil scale may be inscribed at the bottom of the target. A small nail at the top marks the center from which an arc was drawn and provides a hook from which to suspend the plumb line (fig 8-1).

(4) A vertical reference line (fig. 8-1) may be drawn through the center of each diagram. These lines may be used when the trunnions cannot be leveled by setting the testing target with the cant angle of the piece. The target is tilted until the line of sight through the tube tracks between the tube reference line when the tube is elevated or depressed. Then the panoramic telescope is adjusted so that its vertical crosshair tracks between the appropriate reference lines when the tube is elevated or depressed.

(5) To ease boresighting in darkness, a 1/16-inch hole may be bored through the mounted testing target at the center of each aiming diagram. A flashlight held against the target behind the appropriate hole provides an aiming point for use in blackout conditions. Patches of felt padding should be fastened on the back of the target covering the regions of each hole, so that light from the flashlight will not escape. The flashlight must be lit only after it is placed firmly in position. Care must be taken to prevent disturbing the position of the testing target.

c. *Tools*. The section equipment includes all the necessary tools for boresighting and testing. If any item of sighting and fire control equipment fails to meet the prescribed tests, support maintenance personnel must be notified.

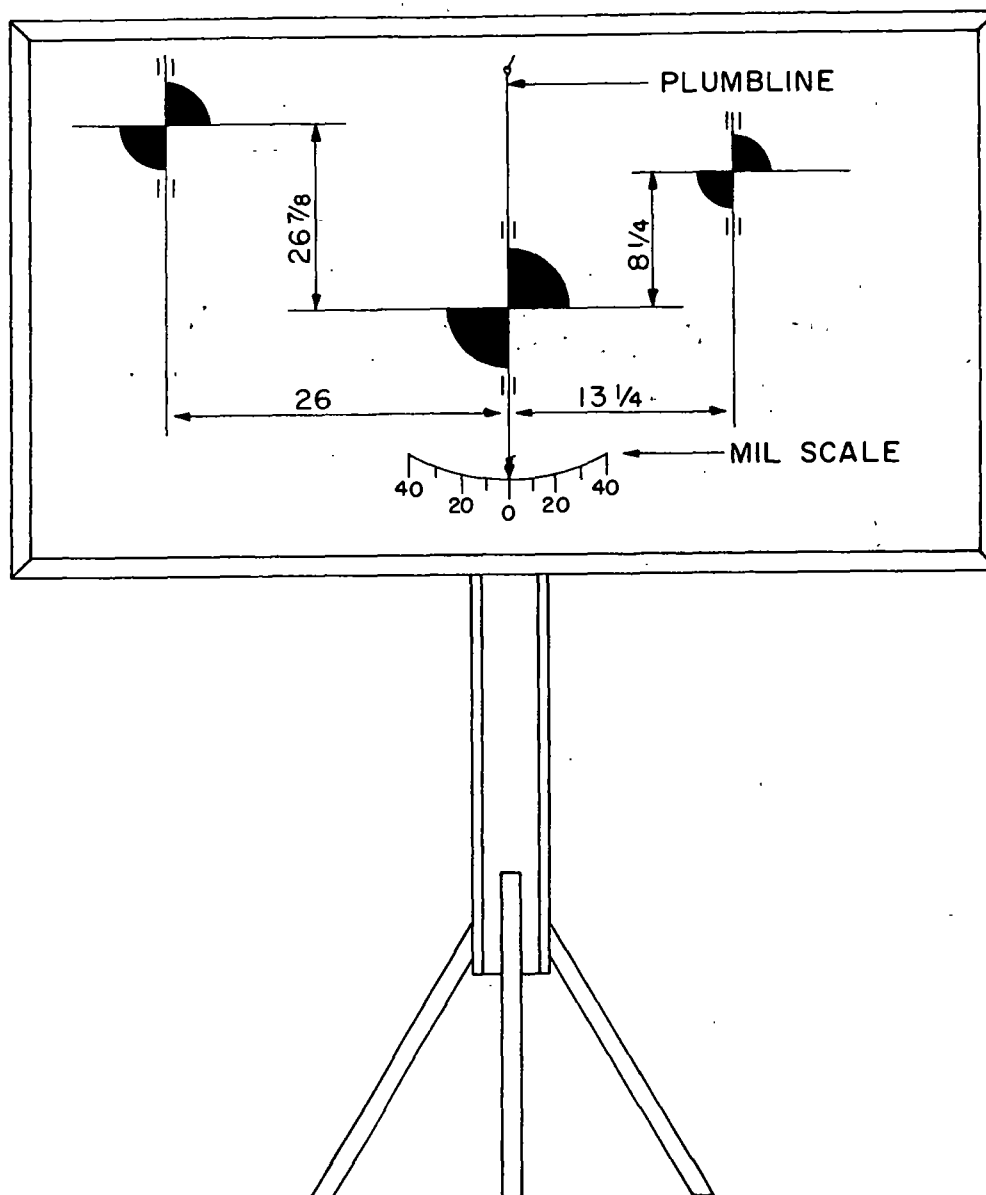


Figure 8-1. Testing target with mil scale and vertical reference lines.

8-3. Conditions

The on-carriage fire control equipment is in correct alinement when the conditions in *a* through *d* below exist.

- a.* Mounts and instruments are securely attached, and there is no binding or excessive backlash between the gears.
- b.* The line of sight of on-carriage sighting equipment are parallel to the axis of the bore throughout the limits of elevation.
- c.* Elevation counter dials read zero.
- d.* The azimuth counter dial reads 3200.
- e.* All level bubbles are centered.

8-4. Leveling

a. Trunnions. Although it is not absolutely necessary to level the trunnions for boresighting, it is advisable to do so whenever possible. Accurate results can be obtained more readily if the trunnions are level, because tilt corresponding to the cant does not have to be introduced in the telescope mount and the testing target when it is used. The trunnions can be leveled by moving the carriage to level ground or by building up the standing for one of the motor carriage tracks or by using a heavy hydraulic jack on the undercarriage of the vehicle.

b. Plumb Line. The best method to check leveling

is by means of the plumb line. The line is suspended directly in front of the axis of the bore at a distance of approximately 15 feet. The line of sight should track the plumb line as the tube is depressed and elevated between minimum elevation and the limits

described by a plumb line which is as long as practicable. The plumb line must be shielded from wind currents, and the plumb bob or weight should be suspended in a container of liquid in order to keep the plumb line steady (fig 8-2).

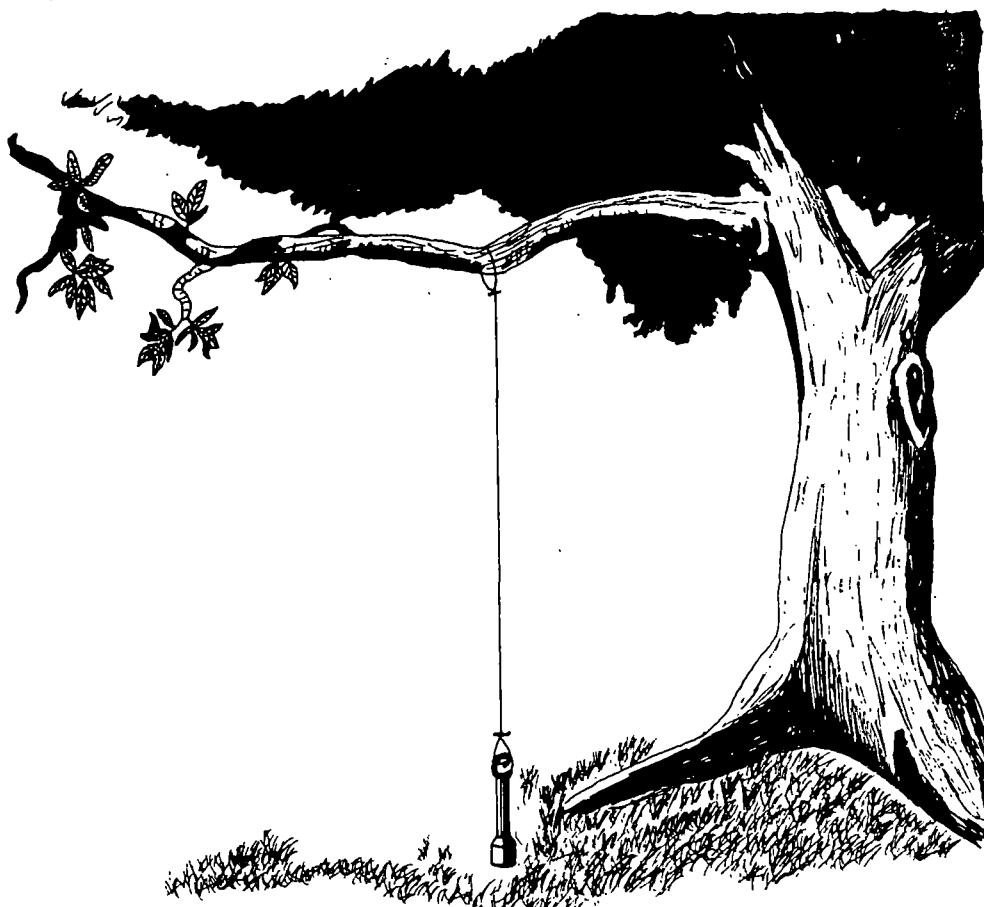


Figure 8-2. Plumb line suspended from tree.

c. *Gunner's Quadrant.* In leveling operations in which the gunner's quadrant is used, a quadrant that has been tested (para 9-3—9-7) and found to be accurate is required. The gunner's quadrant is placed on the cross level pads on the howitzer breech. This

check only approximates the leveling and every effort should be made to center the bubbles by leveling the undercarriage in order to allow sufficient accuracy to conduct reliability test on fire control instruments.

Section II. TESTING TARGET METHOD

8-5. General

The testing target method of boresighting consists of using the aiming diagrams of the testing target as aiming point. The preliminary steps in boresighting are as follows:

a. *Trunnions.* Level the trunnions as described in paragraph 8-4.

b. *Tube.* Level the tube by performing the end for end test on the gunner's quadrant as outlined in paragraph 9-4. Apply the correction determined by the end for end test plus the reading stamped on the howitzer breech ring and set the tube to zero elevation. The number stamped on the howitzer breech is a correction factor to compensate for the

angular difference between the tube and leveling plates on the breech ring. The correction factor must be added or subtracted from the elevation value desired. If the embedded number is "+," add it to the elevation desired; if the embedded number is "-", subtract it from the elevation desired.

c. *Panoramic Telescope Mount M145 and Elevation Quadrant M15.* The panoramic telescope mount M145 and the elevation quadrant M15 are checked by insuring that the bubbles in the elevation level and cross-level vials are accurately centered and all numerical counters read zero. Place a tested gunner's quadrant on the quadrant seat to insure that the error between the tube and the mounts are within plus or minus 0.5 mil. If they are not, the mounts should be adjusted by support maintenance personnel to bring them within tolerance.

d. *Boresights.* Open the breech and insert the breech boresight in the chamber. Attach the muzzle boresight, stretching linen cords across the witness mark and over the cords on the muzzle and securing the ends by placing a strap around the end of the muzzle. If the breech boresight is not available, the obturator spindle vent may be used.

e. *Testing Target Position.* The testing target normally should be located at least 50 to 100 meters in front of the muzzle.

8-6. Testing Target Alinement

Without moving the tube, aline the center aiming diagram of the testing target with the line of sight through the tube. The testing target must be placed perpendicular to the axis of the bore. *The testing target must then be secured.*

8-7. Panoramic Telescope Alinement

Place the panoramic telescope in the telescope mount M145. Set the gunner's aid to zero and adjust the azimuth and reset counters to read 3200. Center the pitch level bubble by rotating the pitch level knob. Adjust the panoramic telescope to the testing target and by rotating the azimuth knob, adjust the vertical line in the reticle of the panoramic telescope on the testing target diagram. The azimuth counter should read 3200, but if it does not, using a small, flat-type screwdriver, fully depress the boresight adjusting shaft and rotate the shaft until the azimuth telescope on the testing target diagram by means of the elevation knob on the telescope.

Caution: TO PREVENT EXTENSIVE DAMAGE TO THE PANORAMIC TELESCOPE M117, THE BORESIGHT ADJUSTMENT SHAFT MUST BE FULLY DEPRESSED BEFORE AN ATTEMPT IS MADE TO ROTATE IT.

8-8. Direct Fire Telescope Alinement.

After the testing target and panoramic telescope alinement have been completed, look through the direct fire telescope to see if the reticle of the telescope coincides with the reticle pattern of the testing target. If it does not, adjust the boresight adjustments of the telescope mount until the reticle of the telescope coincides with the reticle pattern of the testing target. If the reticle of the telescope cannot be made to coincide with the reticle pattern of the testing target, the mount must be adjusted by support maintenance personnel.

Section III. OTHER BORESIGHT METHODS

8-9. Distant Aiming Point Method

A distant aiming point may be used for boresighting if a testing target is unavailable or if the tactical situation makes use of a testing target impractical. The aiming point selected should be a sharply defined, stationary point at least 1,500 meters from the howitzer and as near to howitzer zero elevation as possible. All steps prescribed for the testing target method apply in the distant aiming point method, except that the boresight and the optical sights are alined on the same distant aiming point rather than on displaced points as on the testing target. Accurate leveling of the trunnions is unnecessary when a distant aiming point is used for boresighting. However, the howitzer should be on level terrain if possible.

8-10. Aiming Circle Method

In an *emergency situation* under conditions which preclude use of testing target or distant aiming point boresighting methods, the M2 aiming circle may be used to boresight the howitzer. Procedures are as follows:

a. Prepare the howitzer for boresighting as described in paragraph 8-1 through 8-4. The howitzer tube should be as near zero in elevation as possible.

b. Place the aiming circle 30 to 50 meters in front of the muzzle.

c. Sight through the tube and aline the vertical muzzle boresighting string on the center of the aiming circle objective lens.

d. Sight through the aiming circle and aline the

vertical hairline of the instrument on the vertical muzzle boresighting string with the instrument reading at 3200 on lower motion.

(5) With the instrument upper motion, aline the vertical hairline to the center of the objective lens of the panoramic telescope sight.

(6) Announce the reading (upper scales) on the aiming circle to the gunner.

(7) Set the announced reading on the azimuth counter.

(8) Aline the vertical hairline of the panoramic telescope on the center of the aiming circle objective lens by using the azimuth knob.

(9) Set the announced deflection on the azimuth counter by depressing and turning the boresight adjustment shaft.



CHAPTER 9

BASIC PERIODIC TESTS

Section I. GENERAL

9-1. Purpose and Scope

a. The purpose of this chapter is to describe the procedures for performing basic periodic tests of on-carriage fire control equipment. The procedures covered include only those that may be accomplished at battery level. It is not contemplated that using units will have the necessary facilities, tools, or skilled personnel to perform the more precise tests and adjustments of sighting and fire control equipment. If the elevation counter, telescope mount, or panoramic telescope exceeds the tolerance authorized on any of the tests outlined, the piece and/or panoramic telescope must be sent to support maintenance adjustment.

b. Basic periodic tests are performed by the section under the supervision of the battery executive officer, chief of firing battery, and the artillery mechanic. These tests are performed at the discretion of the unit commander. Suggested times for performance are once each year if the piece is used for nonfiring training; once every 3 months if the piece is fired; as soon as possible after intensive use, following accidents, or after traversing extremely rough terrain; and whenever the piece fires inaccurately for no readily apparent reason. The tests will reveal whether the on-carriage sighting equipment, the gunner's quadrant, and the fuze setter are in the correct adjustment.

curately for no readily apparent reason. The tests will reveal whether the on-carriage sighting equipment, the gunner's quadrant, and the fuze setter are in the correct adjustment.

9-2. Preliminary Conditions

For the on-carriage equipment to be in correct adjustment, the following conditions must exist:

- a. The line of sight of the panoramic telescope remains in a plane parallel to the vertical plane passing through the axis of the bore as the tube is elevated throughout its limits of elevation.
- b. Elevation counters read zero.
- c. The azimuth counter dial reads 3200.
- d. If the elevation level and cross-level bubbles are centered, the telescope mount automatically compensates for error in azimuth caused by elevating the tube.
- e. The sighting equipment is accurately boresighted as described in chapter 8.
- f. Prior to all tests of on-carriage fire control equipment, it is necessary that the trunnion be leveled. Leveling the trunnions is accomplished and verified as described in paragraph 8-4.

Section II. GUNNER'S QUADRANT TEST

9-3. General

The gunner's quadrant must be in proper adjustment before conducting tests and adjustment of other sighting and fire control equipment. Inspect the shoes of the gunner's quadrant for dirt, nicks, or burrs. Also insure that the mating surfaces are clean, otherwise inaccurate readings may be acquired.

9-4. End-for-End Test

a. Set both the index arm and the micrometer scale of the gunner's quadrant at zero, making sure the auxiliary indexes match.

b. Place the quadrant on the quadrant seats of the breech ring with the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by manually elevating or depressing the tube.

c. Reverse the quadrant on the quadrant seats (turn it end-for-end). If the bubble recenters, the quadrant is in adjustment and the test is completed.

d. If the bubble does not recenter, try to center it by turning the micrometer knob. If the bubble centers, read the black figures and divide by 2. The quotient is the correction. Place the correction on the micrometer and level the tube by using the elevation handcrank. Check again by reversing the quadrant. The bubble should center.

e. If the bubble does not center as in *d* above, move the radial arm down one graduation (10 mils) and perform the following operations: Turn the micrometer until the bubble centers; add 10 to the reading on the micrometer, and divide the sum by 2. Place the value of the quotient reading on the micrometer, leaving the arm at minus 10; center the

level bubble with the elevation handcrank; and check by reversing the quadrant on the seats. The bubble should recenter. Subtract the reading on the micrometer from 10 to obtain the error. If the correction of error is more than plus or minus 0.4 mil, the quadrant must be adjusted by support maintenance personnel.

9-5. Micrometer Test

a. Set the radial arm to read 10 mils on the elevation scale, and set the micrometer at 0.

b. Place the quadrant on the quadrant seats on the breech ring with the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by elevating the tube.

c. Set the radial arm at 0 on the elevating scale, and set the micrometer at 10 mils.

d. Reseat the quadrant on the quadrant seats. The bubble should center.

Caution: Do not disturb the laying of the tube.

e. If the bubble does not center, the micrometer is in error and must be adjusted by support maintenance personnel.

9-6. Comparison Test

Compare readings taken at low, medium, and high elevations with each of the gunner's quadrants of a battery on the quadrant seats of a *single* piece. The trunnions of this piece should be level. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to a support maintenance unit for adjustment.

9-7. Correction

When a gunner's quadrant requires a correction as determined by the end-for-end test, this correction is not carried during firing, but it is recorded and applied only when tests are being made.

Section III. TESTS FOR TELESCOPE MOUNT M145 PANORAMIC TELESCOPE, AND ELEVATION QUADRANT M15

9-8. Purpose

The purpose of the tests for the telescope mount M145, the panoramic telescope, and the elevation quadrant M15 is to determine whether the azimuth counter and level vials actually establish the tube, regardless of cant, in the correct vertical plane at all elevations. These tests are performed to check the adjustment and mounting of the panoramic telescope mount, the accuracy of the level vials, and the alinement of the telescope socket. The test of the telescope mount described below may be performed with the trunnions either level or canted.

9-9. Test of Telescope Mount M145 Using a Plumb Line

a. With the boresights in place and the tube at a low elevation, traverse the tube so that the line of sight through the tube is on the plumb line: level the telescope mount by centering both the elevation level and cross-level bubbles.

b. Place the intersection of the crosshairs of the panoramic telescope reticle on any sharply defined aiming point and note the deflection.

c. Elevate the tube from minimum to maximum elevation (or limit of the plumb line) in 100-mil steps. At each step, traverse the tube (if necessary) to bring the line of sight back on the plumb line. Relevel the telescope mount in both directions and check for deviation of the line of sight from the aiming point. If the vertical crosshair is off the aiming point, it is alined on the aiming point with the azimuth knob. If the horizontal crosshair is off

the aiming point, it is alined on the aiming point with the elevation knob, and the bubble displacement is noted.

d. If the vertical crosshair deviates from the aiming point by more than 0.5 mil from the original deflection at any elevation tested or the correction for the deviation of the bubble to move in excess of one-half vial graduation, the telescope mount is out of adjustment or improperly mounted. The weapon must be referred to support maintenance personnel for adjustment or correction.

9-10. Test for Panoramic Telescope

a. Set the azimuth counter dial at 3200.

b. Traverse and elevate the tube as necessary to place the panoramic telescope reticle crosshairs on an aiming point.

c. Rotate the telescope head through a complete circle (6,400 mils). The telescope crosshairs should return to within one (1) mil of the aiming point.

9-11. Orientation Check for the Elevation Quadrant M15

a. Operate the cross level knob to center the bubble in the cross level vial.

b. Rotate the elevation knob to center the bubble in the elevation level vial.

c. Operate the correction knob to set the mil correction counters to 0.

d. Manually elevate or depress the tube to zero elevation by centering the bubble in the elevation vial.

e. Place the gunner's quadrant on the breech quadrant seat and read the elevation, then place the gunner's quadrant on the quadrant seat of the elevation quadrant. If the gunner's quadrant does

not read "0" elevation plus or minus 0.5 mils at *each* location, the weapon should be referred to support maintenance personnel for adjustment or correction.

Section IV. TEST OF FUZE SETTERS

9-12. Time Scale Test

The time scale test is performed to verify that the time set on the fuze agrees, within prescribed tolerances, with the time setting on the fuze setter. This test may be conducted during firing or as a separate test.

Warning: Never use a fuze from a dud.

a. The time set on the fuze should agree with the time setting on the fuze setter within $\frac{1}{4}$ of the smallest graduation on the fuze time ring.

b. If a fuze setting doesn't agree with the time set on the fuze setter, proceed as follows:

(1) Repeat the test as a check with a different setting.

(2) If the fuzes and the fuze setter still don't agree, refer the instrument to organizational maintenance.

c. When tests are complete, reset all fuzes to SAFE and replace the safety wire or cotter pin.

9-13. Test of Fuze Setters

Examine the fuze setters M26 and M28 as follows:

a. Check for burred or dented edges on the stop that fits into the slot of the movable time ring and on the adjusting pawl which engages the notch in the fixed fuze ring.

b. Depress the adjustable pawl against its spring to determine that the movement of the pawl is free.

c. Test the fuze setter with the fuze for which it was designed. The time scale on the fuze setter must have the same graduation as the time ring on the fuze.



CHAPTER 10

MAINTENANCE AND INSPECTIONS

Section I. MAINTENANCE

10-1. General

Maintenance and inspection are needed to insure that the section can carry out its mission. Systematic maintenance and inspection drills give the best insurance against unexpected breakdown at the critical moment when maximum performance is needed. Carriage maintenance for a self-propelled weapon takes on added importance in that ability to fire is dependent on carriage operation.

10-2. Disassembly, Adjustment, and Assembly

Disassemblies and adjustments authorized to be made on the weapon by battery personnel are prescribed in TM 9-2350-217-10, TM 9-2350-217-20, LO 9-2350-217-12 supplemented by instructions in Department of the Army technical manuals. No deviation from these procedures is permitted unless authorized by support maintenance.

10-3. Records

The principal records pertaining to the weapon are the Equipment Log Book, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) and DA Form 2407 (Maintenance Request). For detailed information on the use of these forms, see TM 38-750.

10-4. Maintenance References

Detailed instructions for maintaining the howitzer and carriage are contained in TM 9-2350-217-10 and LO 9-2350-217-12.

10-5. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition.

a. The chief of section is responsible for the equipment in his section. He should inspect it each

day. If he sees the need for repair or adjustment, he notifies the battery executive officer immediately so that the necessary action may be taken.

b. The battery executive officer, with the chief of firing battery and the artillery mechanic, should make a daily spot check inspection. He inspects different parts of the weapons and motor carriages each day to insure complete coverage every few days. At least once a month, the battery executive makes a thorough mechanical inspection of weapons, motor carriages, auxiliary equipment, tools, and repair parts.

c. Battery, battalion, and higher commanders should make frequent command inspections to assure themselves that the equipment in their commands is being maintained at prescribed standards of appearance, condition, and completeness.

d. Detailed instructions for inspecting and servicing the weapon, turret, and carriage by the crew are found in TM 9-2350-217-10, Operator's Manual, and LO 9-2350-217-12, Lubrication Order. Additional instructions for inspecting and servicing the weapon, turret and carriage, and maintenance allocation chart (MAC) are contained in TM 9-2350-217-20, Organization Maintenance Manual.

10-6. Inspection Before Operation

The inspection performed before operation is a final check on material prior to leaving the motor park for training in the field, or the bivouac area for combat, or before displacement. Boresighting is done at this inspection, if time permits. After inspection and after all deficiencies have been corrected, the weapon and carriage are ready for operation. For duties of section personnel, see paragraph 10-7 through 10-15.

Section II. SECTION DUTIES BEFORE OPERATIONS

10-7. Duties of the Chief of Section

a. Supervises the section during the service to insure that checks and services are made in accordance with the technical manual and lubrication order. Makes or revises required entries in the equipment log book.

b. Checks for proper supply of fuel, water, and emergency rations. Verifies that the technical manual equipment log book, driver's accident report form, vehicle accident identification card, and lubrication order are present. Verifies that operator has SF 46 (US Govt Motor Vehicle Operator's Identification Card) on his person.

c. Inspects ammunition for proper lot number, condition, and stowage. Inspects loading of section equipment for completeness and security. Reports "Sir, No. () in order," or any defects the section cannot remedy without delay.

10-8. Duties of the Gunner

a. Checks gunner's elevation and traversing lock for proper operation. Checks intercommunications system for proper operation. Checks equilibrator system for adjustment. Checks recuperator for correct fluid content. Checks turret hydraulic connections.

b. Checks panoramic telescope and mount for damage, operation, and cleanliness. Checks gunner's quadrant for damage, operation, and cleanliness. Reports "Ready," and takes post.

10-9. Duties of the Assistant Gunner

a. Checks elevation controls for proper operation. Checks elevation cylinder for proper operation. Checks variable recoil cylinders and replenisher for fluid content. Checks gun shield seal and cab race ring seal inflation air pump, and air gauge for proper operation. Checks portable fire extinguishers. Checks cab hydraulic system power pack and equilibrator gauge.

b. Checks direct fire telescope and mount for damage, operation, and cleanliness. Checks elevation quadrant for damage, operation, and cleanliness. Checks the elevation and traversing ring gears, cab leaks and seeps, recoil cylinder and replenishes fluid leaks and hydraulic system.

c. Checks operation of the breechblock and cleans with a dry cloth. Checks operation of the firing mechanism and cleans as needed. Checks operation of the power rammer. Reports "Ready," and takes post.

10-10. Duties of Number 1 (Left Side)

a. Checks condition of track shoes, pads, and guides. Checks for leaks and condition of the hydraulic track adjuster. Checks for loose, damaged or worn drive sprockets. Checks for loose or damaged road wheels. Checks for loose end connectors. Checks for loose or damaged idler wheel. Checks for broken welds and missing parts.

b. Checks fixed fire extinguisher actuating handler for damage, corrosion, and broken seal. Checks condition and security of the flotation device. Cleans bore and chamber with clean dry cloth. Reports "Ready," and takes post.

10-11. Duties of Number 2 (Right Side)

Number two performs the same duties as outlined in 10-10a. Number two also checks cab hydraulic system power pack oil reservoir. Reports "Ready," and takes posts.

10-12. Duties of Number 3 (Left Side)

a. Checks hydraulic shocks for leaks and support arms for water contamination. Checks oil level in road wheel hubs. Bubbles and yellow discoloration of the oil in the sight plugs indicate water contamination.

b. Checks gun travel lock for secure mounting. Checks off-set periscope for damage. Cleans and lubricates fuze setters. Loads ammunition and equipment. Reports "Ready," and takes post.

10-13. Duties of Number 4 (Right Side)

Number four assists number three in the duties outlined in 10-12a. Number four also cleans all exterior lights and checks for proper operation. Checks condition and completeness of all exterior mounted equipment. Checks for broken welds and missing parts. Checks for completeness and security of all exterior mounted equipment. Reports "Ready," and takes post.

10-14. Duties of Number 5

Number five checks all doors and hatches for proper operation and condition of seals. Checks spades for secure mounting. Checks tow pintle for secure stowage. Checks machinegun and mount for operation and cleanliness. Checks stowage of machinegun ammunition. Checks spades for cracks, strut lock for proper adjustment. Reports "Ready," and takes post.

10-15. Duties of the Driver

The driver performs the following duties: Checks foot controls. Checks instrument and warning lights for normal indication. Checks vehicle steering action. Checks hand controls. Checks periscopes. Checks fixed fire extinguisher activating handle for damage, corrosion, and broken seal. Checks transmission control. Checks exterior lights with help of number four. Checks radiator water level and adds water if needed. Checks engine oil level and adds oil if needed. Refuels vehicle as required. Checks transmission oil level and adds oil if needed. Checks batteries and cables for corrosion. Checks that the driver's hatch is locked when operating the equipment with the hatch open. Reports "Ready," and takes post.

Section III. SECTION DUTIES DURING OPERATIONS

10-16. Inspection During Operation

The inspections performed during operation are constant checks on the functioning of the vehicles and the security of all stowed equipment. The responsibilities and duties of section personnel are as follows:

a. The chief of section and senior cannoneer supervise march discipline of the motor carriage and section vehicle and assist the driver's in detecting obstacles that would cause injury to personnel or damage to the vehicles.

b. The gunner, assistant gunner, and cannoneers inspect security of stowed equipment and act as air sentinels as directed by the chief of section.

c. The operators operate their respective vehicles and inspect all instruments and controls.

10-17. Inspection During Halt

The inspection at the halt is made to insure that the motor carriage, weapon, and section vehicle are in satisfactory operational condition. The halt provides the section with an opportunity to inspect for malfunctions that cannot be detected during operation.

10-18. Inspection and Maintenance After Operation.

Immediately after operation, the motor carriage, weapon, and section vehicle are serviced and maintained as necessary to prepare them for further sustained action or to determine the need for maintenance by higher categories. Boresighting is accomplished, if time permits. These operations may be performed in the motor park, bivouac area, or combat position. Individual duties of howitzer section personnel are listed in paragraphs 10-19 through 10-22.

10-19. Duties of the Chief of Section

The chief of section supervises the section during the service. Insures any equipment faults found and not corrected on the spot are recorded on DA Form 2404. Reports "Sir, number () in order," or any defects the section cannot remedy without delay.

10-20. Duties of the Gunner and Assistant Gunner

The gunner (left side) and assistant gunner (right side) check presence, security, and condition of sighting equipment. Check security of ammunition and all equipment inside the vehicle. Check for any hydraulic oil leaks. Check condition and completeness of all exterior mounted equipment. Check for broken welds and missing parts. Report "Ready."

10-21. Duties of Number 1 and Number 2

Numbers 1 (left side) and 2 (right side) check condition of track shoes, pads, and guides. Check for leaks and condition of the hydraulic track adjuster. Check for loose or damaged drive sprockets. Check for loose or damaged road wheels. Check for loose end connectors. Check for loose or damaged idler wheels. Check hubs for excessive heat. Check shocks for correct temperature. Report "Ready."

10-22. Duties of the Drivers

The drivers check engine oil level and add oil if necessary. Refuel vehicle if required. Check transmission oil level and add oil if required. Check foot controls. Check instruments and warning lights for normal indication. Check vehicle steering action. Check hand controls. Check periscopes. Report "Ready."

Section IV. AFTER OPERATION CHECK AND WEEKLY MAINTENANCE INSPECTION

10-23. Duties of the Chief of Section in After Operation Checks

The chief of section checks for proper supply of fuel, water, and emergency rations. Verifies that the technical manual, driver's accident report form, vehicle accident report form, vehicle accident identification card, and lubrication order are present. Completes entries in the equipment log book. Completes DA Form 2404. Supervises the section during the service. Insures equipment is refueled.

Inspects the vehicle. Reports "Sir No () in order," or any defects the section cannot remedy.

10-24. Duties of the Gunner

The gunner checks gunner's elevation and traversing controls for ease of operation. Checks cab traverse lock for proper operation. Checks intercommunication system for proper operation. Checks equilibrator system for adjustment. Checks recuperator for correct fluid content. Checks hydraulic connections on the recoil mechanism.

Checks panoramic telescope and mount for damage, operation, and cleanliness. Reports "Ready."

10-25. Duties of Assistant Gunner

The assistant gunner checks direct fire telescope and mount for damage, operation, and cleanliness. Checks elevation quadrant for damage, operation, and cleanliness. Checks hydraulic connectors in turret for leaks and seeps. Checks the elevation and traversing ring gears. Checks elevation controls for proper operation. Checks elevation cylinder for proper operation. Checks variable recoil cylinders and replenishes for fluid content. Checks portable fire extinguisher. Checks cab hydraulic system power pack, and equilibrator sight gauge. Checks operation of the breechblock, cleans and oils as required. Checks operation of the firing mechanism and cleans as required. Checks operation of the power rammer and cleans as required. Reports "Ready."

10-26. Duties of Number 1 (Left Side) and Number 2 (Right Side)

Check track tension and condition of track shoes, pads and guides. Check for leaks and condition of the hydraulic track adjuster. Check for loose and damaged road wheels. Check for loose track pin bolts. Check for loose or damaged idler wheel. Check for loose or damaged drive sprockets. Check hubs for excessive heat. Check for broken welds. Clean and lubricate the bore and chamber. Report "Ready."

10-27. Duties of Number 3 (Left Side)

a. Checks hydraulic shocks for leaks. Checks oil level in road wheel hubs. Bubbles and yellow discoloration of the oil in the sight plugs indicate water contamination.

b. Checks gun travel lock for securing mounting. Checks offset periscope for damage. Checks that the muzzle brake and evacuator are not damaged. Cleans and lubricates fuze setters. Reports "Ready."

10-28. Duties for Number 4 (Right Side)

Number four assists number three in the duties

outlined in paragraph 10-27a. Number 4 also checks all exterior lights for proper operation. Checks for broken welds and missing parts. Checks air cleaner and cleans filter pan. Cleans the howitzer and the vehicle. Reports "Ready."

10-29. Duties of Number 5

Number 5 checks machinegun and mount for operation. Cleans machinegun. Check tow pull for secure stowage. Checks all doors and hatches for proper operation and condition of seals. Checks spades for secure mounting. Reports "Ready."

10-30. The Duties of the Drivers

The drivers check radiator water level and add water if required. Check engine oil level and add oil if required. Refuel vehicle as required. Check electrolyte level in batteries. Check battery hold down brackets and cables for looseness and corrosion. Check foot controls. Check instruments and warning lights for normal indication. Check vehicle steering action. Check hand controls. Check periscopes. Report "Ready."

10-31. Section Duties in Weekly Inspection and Maintenance

In garrison, inspection and maintenance duties are performed weekly; on maneuver or in combat they are performed after each field operation.

a. *Chief of Section.* The chief of section supervises the section during inspection and maintenance of the howitzer motor carriage, section vehicle, tools, accessories, and equipment in accordance with TM 9-2350-217-10 and LO 9-2350-217-12. He obtains the assistance of the artillery mechanic and battery mechanic for operations requiring skill and tools beyond the capabilities of the section.

b. *Gunner, Assistant Gunner, and Cannoneers.* The gunner, assistant gunner, and cannoneers perform normal maintenance as directed by the chief of section.

c. *Drivers.* The operators perform normal preventive maintenance services in accordance with appropriate technical manuals.

CHAPTER 11

DECONTAMINATION OF EQUIPMENT

11-1. General

Equipment which has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. *Contamination* means the spreading of an injurious agent in any form and by any means. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or thing safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Generally, only equipment contaminated by persistent agents needs be decontaminated.

11-2. Decontamination for Chemical Agents

a. Ammunition. With rags, wipe off visible contaminant from projectiles. Apply DANC (decontamination agent, noncorrosive, M4), wipe with solvent-soaked rag, and then dry. If DANC is not available, scrub with soap and cool water. Slurry (equal weights of water and chloride of lime) can be used on contaminated ammunition containers, but it must not be allowed to penetrate into the ammunition itself.

b. Instruments. If exposed to corrosive gases, clean instruments as soon as possible with solvent, allow them to aerate, and apply a thin coat of light machine oil. A rag dampened with DANC may be used, followed by drying with a clean rag and then applying a coat of machine oil. DANC DAMAGES CLEAR PLASTIC OR HARD RUBBER SURFACES.

c. Weapons. Remove dirt, dust, grease, and oil from weapons. Do not apply wet mix but allow surfaces to air after oil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Also effective on metal are hot water and soap or cleaning solvent. After decontamination, weapons are dried and oiled.

d. Automotive Equipment. Exposure to the air can neutralize light contamination from spray. For heavy contamination, use DANC on interior or exterior surfaces that personnel are likely to touch. For large areas of decontamination, wash vehicle with water and scrub painted surfaces with soap and water.

11-3. Decontamination for Biological and Radiological Agents

a. General. After activity involving enemy use of biological and/or radiological agents, recovery of equipment may be achieved either by waiting, to permit the decay of contamination, or by active decontamination, to reduce the danger to a level where it is no longer a significant hazard to operating personnel. Decontamination may be either rough or detailed, depending on the urgency of the military situation. The procedure adopted will be a command decision.

b. Rough Decontamination. Rough decontamination is performed with urgency is the main factor. Its purpose is to reduce contamination sufficiently to permit personnel to work with, or close to, equipment for limited periods. Rough decontamination may be achieved by means of water or steam, if available. Soap or other detergent used in conjunction with water or steam aids in decontamination.

c. Detailed Decontamination. Detailed decontamination, in which the emphasis is on thoroughness, will be carried out in rear areas and repair bases and includes procedures of surface decontamination, aging, sealing, and disposal.

11-4. References

For further information on decontamination, see FM 21-40 and TM 3-220.



CHAPTER 12

DESTRUCTION OF EQUIPMENT

(STANAG 2113)

12-1. General

a. Tactical situations may arise in which it is necessary to abandon equipment in the combat zone. In such a situation, all abandoned equipment must be destroyed to prevent its use by the enemy.

b. *The destruction of equipment subject to capture or abandonment in the combat zone will be undertaken only upon authority delegated by a division or higher commander.*

12-2. Plans

All batteries will prepare plans for destroying their equipment in order to reduce the time required should destruction become necessary. The principles to be followed are —

a. Plans for destruction of equipment must be adequate, uniform, and easily carried out in the field.

b. Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, *priorities* must be established so that the more essential parts are destroyed first. Priorities are—

- (1) Breech, breech mechanism, and spares.
- (2) Recoil mechanisms.
- (3) Tube.
- (4) Sighting and fire control equipment.
- (5) Carriage and tires (engine).

c. The same essential parts must be destroyed on

all like units to prevent the enemy from constructing a complete unit from undamaged parts.

d. Spare parts and accessories must be given the same priorities as the part installed on the equipment.

12-3. Methods of Destruction

a. Selection of the method of destruction most suited to the M109 and M109A1 firing battery depends on the use of materials immediately available. The most generally applicable methods of destruction are mechanical destruction, burning, demolition, and destruction by gunfire.

(1) Mechanical—Requires an ax, a pick, a sledge, or similar equipment.

(2) Burning—Requires gasoline, oil, incendiary devices, or other flammables.

(3) Demolition—Requires ammunition or explosives.

(4) Gunfire—Requires field artillery, rocket launchers, recoilless rifles or machineguns.

b. In general, destruction of essential parts followed by burning of the equipment is sufficient to render the equipment useless.

12-4. References

For detailed information on destruction of the howitzer, fire control equipment, and the motor carriage, see TM 750-244-7.



CHAPTER 13

SAFETY PRECAUTIONS

Section I. GENERAL

13-1. Safety Precautions

Safety precautions to be observed in training are prescribed in AR 385-63. Additional information is found in FM 6-40, FM 6-140, TM 9-1300-203, and TM 9-2350-217-10. The more important safety precautions are summarized in the following paragraphs.

13-2. Ammunition

a. All ammunition on the ground at the firing position must be so placed that it is protected against explosion in case of an accident at the piece. Fire and explosive or flammable materials must be kept away from ammunition. Ammunition should be protected from direct rays of the sun by use of a tarpaulin or other suitable covering.

b. Battery personnel must not attempt to disassemble fuzes.

c. If for any reason a round is not fired after the time fuze has been set, the fuze must be reset to SAFE before it is restowed. M514-series VT fuzes must be reset to initial setting as shipped.

d. All rounds not fired which have been prepared for firing must be checked by the chief of section to insure that all powder increments are present in proper order and condition and that they are of the proper lot number. For further details, see FM 6-40, FM 6-140 and TM 9-2350-217-20.

13-3. Drill and Firing

a. The piece is kept unloaded except when firing is imminent.

b. Personnel on the ground will pass in rear of the carriage when they go from side to side.

c. Personnel must stay a safe distance from the breech to prevent injury when the piece recoils.

d. During firing, personnel should protect their

eardrums against injury by using earplugs or other suitable material.

e. Definitions.

(1) *Checkfire*. A checkfire is a command, normally given by the executive officer, but, in an emergency, may be given by anyone present, which halts a fire mission.

(2) *Cold Tube*. A tube that has not exceeded the prescribed rates of fire and does not cause water from a wet swab to boil, fry or steam-off when placed just forward of the gas check seat.

(3) *Hot Tube*. A tube that has or has not exceeded the prescribed rates of fire and does cause water from a wet swab to boil, fry or steam-off when placed just forward of the gas check seat.

(4) *Cookoff*. A cookoff is the functioning of the propelling charge when initiated by the heat of the weapon.

(5) *Hangfire*. A hangfire is a delay in the functioning of the primer, igniter or propelling charge. This delay, though unpredictable, ranges from a fraction of a second to 10 minutes.

(6) *Misfire*. A misfire is when the weapon does not fire after an attempt to fire has been made. This failure may be due to failure of the primer, igniter, propelling charge, or firing mechanism to function wholly or in part. A misfire in itself is not dangerous, however, it cannot be immediately distinguished from a *hangfire* or a *sticker*. Misfires must be treated as *hangfires* or *stickers* until otherwise determined.

(7) *Sticker*. A sticker is a projectile that is lodged in the tube after normal functioning of ignition train. Stickers may occur when firing at Charge 1 with the M109A1. When stickers occur, gasses under high pressure are retained in the chamber.

Section II. MISFIRE PROCEDURES

13-4. General

Conditions described in this section are rarely encountered when authorized and properly maintained ammunition is fired in a properly maintained and operated weapon. However, to avoid injury to

personnel and damage to equipment, it is important that all concerned understand the following:

(1) What is involved when the weapon fails to fire.

(2) What should be done when a failure to fire occurs.

13-5. Precautions

Precautions in firing M109 or M109A1 are the same with the exception of those while firing Charge 1 with the M109A1 and the time interval at which cookoffs may occur if the authorized rates of fire for either weapon are exceeded.

a. When the authorized rates of fire for the M109 are exceeded, propelling charge cookoffs may occur within 5 minutes after chambering.

b. When the authorized rates of fire for the M109A1 are exceeded, propelling charge cookoffs may occur within 1 minute after chambering.

c. See table 13-1 for rates of fire.

Table 13-1. Rates of Fire

Max Rate	M109 4 rds / min for 3 min	M109A1 4 rds / min for 3 min
Sustained Rate Charge 1-7 Charge 8	1 rd/min Not Applicable	1 rd/min 1 rd/min for 60 min 1 rd/3 min thereafter

Warning: Do not use charge 1 with the M109A1 except under combat emergency conditions.

13-6. Misfire Procedures

a. *Failure To Fire with a colt tube.*

(1) If weapon fails to fire after one attempt to fire, immediately attempt to fire two more times.

(2) If weapon still fails to fire, wait 2 minutes from the first attempt before removing primer.

Warning: Stand clear of recoiling parts exposing only the hand and the arm when removing the primer.

(3) After removal of primer involved in failure to fire, separate from other primers until it has been determined whether primer or firing mechanism was at fault.

(a) If primer is determined to be at fault, continue to keep separate from the primers until disposed of.

(b) Insert new primer and attempt to fire.

Caution: A LANYARD OF AT LEAST 50 FT SHOULD BE USED IF ROUNDS REMAIN IN TUBE LONGER THAN 15 MINUTES.

(4) If primer has fired, wait 10 minutes from first attempt to fire (8 minutes from removal of primer) before removing charge.

b. *Failure To Fire With a Hot Tube.*

(1) If weapon fails to fire after one attempt to fire, attempt to fire two more times.

Warning: Stand clear of recoiling parts exposing only the hand and the arm when removing the primer.

If a commander, in order to avoid prolonged loss of weapon, determines to fire projectile, it must be fired within 5 minutes following projectile chambering.

(2) If weapon fails to fire, wait 2 minutes after first firing attempt and remove primer.

(3) Immediately inspect primer. If primer is determined to be at fault, immediately insert new primer and attempt to fire.

(4) If firing mechanism is determined to be at fault, immediately replace/repair faulty component and attempt to fire.

Warning: Do not open breech if weapon fails to fire.

(5) If weapon still fails to fire, evacuate all personnel.

(6) Wait 2 hours, then proceed as follows:

(a) Remove primer and propelling charge.

(b) Place waste in the chamber.

(c) Close breech.

(d) Lock in traveling position.

(e) Carefully move weapon to a remote location if required.

Warning: Do not attempt to remove projectile.

(7) Request EOD or direct support maintenance personnel to remove projectile or to remove cannon with seated projectile.

c. *Checkfire in a Hot Tube.*

Warning: Fire or remove projectile within 5 minutes following chambering.

(1) If the fire mission is stopped after weapon has been loaded, fire weapon with PROPER AUTHORITY or remove primer, propelling charge, and projectile.

(2) If projectile cannot be removed from the weapon within 5 minutes, evacuate all personnel from the area.

(3) Wait 2 hours, then proceed as follows:

(a) Remove primer and propelling charge.

(b) Place waste in the chamber.

(c) Close breech.

(d) Lock cannon in traveling position.

(e) Carefully move weapon to remote location, if required.

Warning: Do not attempt to remove the projectile.

(4) Request EOD or direct support maintenance personnel to remove projectile or to remove cannon and seated projectile.

13-7. Misfire of M109A1, Charge 1

a. *Charge 1 Misfire in a Cold Tube.*

(1) If a weapon fails to fire after one attempt to fire, immediately attempt to refire two more times.

(2) If weapon still fails to fire:

(a) Wait 2 minutes.

(b) Open rear of cab.

(c) Position tube so that the primer can be expelled through the opening in the cab should there be a sticker.

Note. Stickers may occur when firing Charge 1. When stickers occur, the projectile lodges in the tube and hot gasses under pressure are trapped within the chamber. Removal of the primer is dangerous as it will be expelling rearward when released. The expelled primer and the escaping gases may cause injury to personnel standing in its path.

Warning: Do not stand behind breech when removing the primer.

Do not grasp the firing lock assembly so that the hand is exposed to being hit by the expelled primer.

(3) Stand well to the right side of the breech. Manually grasp the knob on the firing lock assembly and pull outward until it is free to be opened.

(4) Keeping the knob out, firmly slide the firing lock assembly towards the open position until the primer pops and the gasses are vented or the primer is ejected normally.

(5) If a sticker occurred, refire at Charge 4 or above, **WITH PROPER AUTHORITY** (battery commander, executive officer, or officer in charge).

Note. No significant range loss is expected when firing after a sticker.

(6) If a sticker is not involved, determine whether primer or firing mechanism was faulty.

(a) If primer is determined to be faulty, insert new primer and attempt to fire.

(b) If there was a faulty firing mechanism, primer may be reloaded and fired after correction of faulty firing mechanism has been made.

(7) If primer has fired, wait 10 minutes from last attempt to fire (8 minutes after removal of primer) before removing charge.

b. Charge 1 Misfire in a Hot Tube.

(1) If weapon fails to fire after one attempt to fire, immediately refire 2 more times.

Warning: Primer removal may expose cannoner to the danger of a recoiling weapon if a hangfire condition exists. If a commander, in order to avoid prolonged loss of weapon, determines to fire projectile it must be fired within 5 minutes following projectile chambering.

(2) If weapon fails to fire, wait 2 minutes after last firing attempt.

(3) Evacuate extra personnel a safe distance, open rear of cab and position tube so that primer can be expelled through the opening in the cab should there be a sticker.

Note. Stickers may occur when firing Charge 1. When stickers occur, the projectile lodges in the tube, gases under pressure are trapped within the chamber. Removal of the primer is dangerous as it will be expelled rearward when released. The expelled primer and the escaping gases may cause injury to any one standing in its path.

Warning: Stand clear of recoiling parts, exposing only the hand and the arm when removing the primer before the end of the safe waiting period. Do not grasp the firing lock assembly so that the hand is exposed to being hit by the expelled primer.

(4) Stand to the right side of the breech. Manually grasp the knob on the firing lock assembly and pull outward until it is free to be opened. Keeping the knob out, firmly slide the firing lock assembly towards the open position until the primer pops and the gasses are vented, or the primer is ejected normally.

(5) If a sticker occurred, immediately refire at charge 4 or above **WITH PROPER AUTHORITY** (battery commander, executive officer, or officer in charge).

(6) Immediately inspect the primer if it is ejected normally. If the primer is determined to be faulty, immediately insert primer and attempt to fire.

(7) If firing mechanism is determined to be faulty immediately replace/repair faulty component and attempt to fire.

Warning: Do not open breech if weapon fails to fire.

(8) If weapon still fails to fire, evacuate all personnel.

(9) Wait 2 hours, then proceed as follows:

(a) Remove the primer and propelling charge.

(b) Place waste in the chamber.

(c) Close the breech.

(d) Lock the cannon in traveling position.

(e) Carefully move weapon to remote location, if required.

Warning: Do not attempt to remove the projectile.

(10) Request EOD or direct support maintenance personnel to remove projectile or to remove cannon with seated projectile.

DUDS

Warning: Do not touch, move, or otherwise handle duds; their fuzes may be armed. Have duds destroyed in place by authorized personnel only.

13-8. Safety Officer

In training, there must always be a safety officer for each field artillery unit engaged in firing. For duties of the safety officer, see FM 6-40.



CHAPTER 14

TRAINING

Section I. GENERAL

14-1. Purpose and Scope

The purpose of this chapter is to present the requirements for training section personnel in the performance of their duties in service of the piece. It includes general information on the conduct of training, and tests for the qualification of gunner. (See chapter 15 for detailed instruction for qualification of gunners.)

14-2. Objectives

The objectives of training are to speed the attainment of proficiency by cannoneers in their individual duties and, through drill, to weld them into an effective, coordinated team that is able to function efficiently in combat. During training, the supervisor should keep in mind the proficiency sought by the appropriate Army Training Tests (ATT). Maximum efficiency is attained through regular drills.

14-3. Conduct of Training

a. Training will be conducted in accordance with the principles set forth in FM 21-5. The goal of training should be the standards set forth in FM 6-125, AR 611-201, ATP 6-100 and DA PAM 350-31-2.

b. In general, individual training is conducted by noncommissioned officers as far as practicable. Officers are responsible for preparing training plan, for conducting unit training, and for supervising and testing individual training.

c. Throughout training the application of prior

instruction to current training must be emphasized.

d. A record of the training received by each individual in the section should be maintained on a progress card by the chief of section. This card should show each period of instruction attended, tests taken, and remarks pertaining to progress. Progress cards should be inspected frequently by the chief of firing battery and the battery executive to make sure they are being kept properly and to determine the state of training. Requiring the chief of section to keep these records emphasizes his responsibility toward his section.

e. *Section Drill.* Each member of the section should know the duties of all other members and be able to perform efficiently in each duty position.

f. The necessity for developing leadership and initiative in noncommissioned officers must be emphasized constantly throughout training.

g. *Instructional Material.* A catalog of instructional material for unit, section and staff training is prepared periodically by the US Army Field Artillery School. The instructional material listed in the catalog will assist in conducting training by providing the latest available information in field artillery tactics, techniques and allied subjects. The catalog of Instructional Material is available to Active Army, Reserve and National Guard units upon written request to Commandant, US Army Field Artillery School, ATTN: ATSF-AW, Fort Sill, Oklahoma, 73503.

Section II. MINIMUM TRAINING SCHEDULE

14-4. General

The training schedule outlined in paragraph 14-6 is a guide to meet the minimum training requirements for personnel of a howitzer section in subjects covered in this manual.

14-5. Individual Periods

a. Individual periods of training in service of the piece should be arranged, along with other battery training, into a balanced training program, taking into consideration the basic principles of training.

b. In general, except for service practice, periods on any subject should not be longer than 1 hour. Section drill periods should not exceed one-half hour and should be conducted in a vigorous manner.

c. Periods of drill should be preceded and followed by periods on subjects that are logically related to the drill. For example, a period of drill should be preceded by a period of testing and adjustment of sighting and fire control equipment and followed by a period of inspection and maintenance drills. A

period on aiming post and/or collimator displacement correction may come between two periods of howitzer drill.

d. TM 9-2350-217-10 provides information on which to base periods of instruction on description, characteristics, and functioning of the piece; familiarization with the piece, including breech and

firing mechanisms, barrel assembly and slides, recoil mechanism, equilibrator, elevating mechanism, and sighting and fire control equipment; and field assembly and malfunction. These periods should be included in the battery training schedule and closely allied with the training in service of the piece.

14-6. Training Schedule Outline (78 Hours)

Method	Hours	Subject	Text references	Training aids and equipment
	1	Organization and composition of howitzer section, general duties of individuals, and formation of howitzer section.	Chap 2	Howitzer and motor carriage.
C, D, PW.	1	Posts and posting, changing posts, and mounting and dismounting.	Chap 3, Sec II.	Do.
C, D, PW.	2 (1-hour periods).	Prepare for action. March order.	Chap 4	Do.
C, D, PW.	24 (½-hour periods).	Howitzer drill, duties in firing by indirect laying.	Chap 5	TOE equipment.
C, D, PW.	9 (½-hour periods).	Howitzer drill, duties in firing by direct laying.	Chap 6	Do.
C, D, PW.	6 (1-hour and ½-hour periods).	Tests and adjustment of sighting and fire control equipment.	Chap 9	Do.
C, D, PW.	2 (½-hour periods).	Aiming post displacement correction.	Para 7-4	TOE equipment, black-board, and chalk.
C, D, PW.	4 (1-hour periods).	Maintenance and Inspections.	Chap 10	TOE equipment.
C, D, PW.	1	Decontamination of materiel.	Chap 11	Decontamination and TOE equipment.
C, D, PW.	1	Destruction of material to prevent use by the enemy.	Chap 12	Demolition equipment.
C, D.	1	Safety precautions.	Chap 12	TOE equipment.
PW.	16 (4-hour periods).	Service practice, firing by indirect laying.	Chap 5	Do.
PW.	4	Service practice, firing by direct laying.	Chap 6	Do.
C, PW.	6 (1-hour periods).	Review and tests of subjects previously covered.	All previous references.	Do.

C—Conference; D—Demonstration; PW—Practical Work.

CHAPTER 15

TESTS FOR QUALIFICATION OF GUNNERS

Section I. GENERAL

15-1. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purposes of the tests are—

a. To provide a means of determining the relative proficiency of the individual field artillery soldier in his performance of the principal duties of the gunner and specified duties of the chief of section and assistant gunner which the gunner is expected to perform when called upon to do so. *The tests will not be a basis for determining the relative proficiency of batteries or higher units.*

b. To serve as an addition to training.

15-2. Standards of Precision

The candidate will be required to perform the tests in accordance with the standards listed in *a* through *d* below.

a. Settings must be exact.

b. Level bubbles must be centered exactly.

c. The vertical crosshair in the reticle of the panoramic telescope must be alined on the left edge of the aiming post or the zero line of the collimator, or on exactly the same part of the aiming point each time the piece is laid.

d. Final motions of the azimuth and elevation settings knobs must be made in the appropriate direction (para 7-1). Bubbles must be centered using the hydraulic (power) elevating and traversing controls.

e. The appropriate elevation correction must be set on the correction indicator dial.

15-3. Assistance

The candidate will receive no unauthorized assistance. Each candidate may select authorized assistants as indicated in the tests. If a candidate fails any test because of the fault of the examiner or

any assistant, the test will be disregarded, and the candidate will be given another test of the same nature.

15-4. Time

The time for any test will be the time from the last word of the command to the last word of the candidate's report. The candidate may begin any test after the first word of the first command and should not be charged for any time used by the examiner.

15-5. Scoring

Scoring will be conducted in accordance with the two subparagraphs entitled *Penalties* and *Credits* under each subject. If a test is performed correctly, credit will be given in accordance with the subparagraph entitled *Credit* under each subject. No credit will be allowed if conditions exist as specified in the subparagraph entitled *Penalties*. No penalty will be assessed in excess of the maximum credit for each test.

15-6. Preparation for Tests

The piece will be prepared for action and the candidate posted at the proper position corresponding to the test being conducted or as indicated in the *Special Instructions* subparagraphs under each subject. The examiner will insure that the candidate understands the requirements of each test and will require the candidate to report "I am ready," before each test.

15-7. Qualification Scores

Minimum scores required for qualification in the courses are as follows:

<i>Individual classification</i>	<i>Points</i>
Expert gunner	90
First-class gunner	80
Second-class gunner	70

15-8. Outline of Tests

Paragraph	Subject	Number of tests	Points each	Maximum credit
15-9	Direct laying, panoramic telescope	4	2	8
15-10	Direct laying, direct fire telescope	4	2	8
15-11	Indirect laying, deflection only	18	2	36
15-12	Laying for quadrant with the elevation counter	3	2	6
15-13	Laying for quadrant with the gunner's quadrant	3	2	6
15-14	Displacement correction	2	—	4
	Part I	(1)	3	(3)
	Part II	(1)	1	(1)
15-15	Measuring site to the crest	1	4	4
15-16	Measuring quadrant	1	4	4
15-17	Measuring deflection	1	4	4
15-18	Tests and adjustments of sighting and fire control equipment.	5	—	10
	Tests 1 and 2	(2)	1	(2)
	Test 4	(1)	2	(2)
	Tests 3 and 5	(2)	3	(6)
15-19	Material	3	—	10
	Test 1	(1)	3	(3)
	Test 2	(1)	3	(3)
		(1)	4	(4)
Total credit				100

Section II. TESTS

15-9. Direct Laying, Panoramic Telescope

a. Scope of Test. Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below. Each group of tests will be executed as one series of commands.

b. Special Instruction.

(1) Place a stationary target approximately 600 meters from the howitzer.

(2) Set azimuth counter to 3,200 mils, and set

the gunner's aid counter to zero.

(3) Point howitzer so that a 100-mil shift is required for tests 1 and 3.

(4) Post the candidate as the gunner.

(5) The laying of the piece will not be disturbed after tests 1 and 3.

(6) The examiner will reverse the assumed direction of movement for test 3.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1 and 3	<i>TARGET: THAT TANK, SHELL HE, CHARGE 7, FUZE QUICK. LEAD RIGHT 10, RANGE 800.</i>	Sets lead on the azimuth counter. Traverses tube until vertical reticle is on the center of the target mass. Centers the pitch and cross-level bubbles. Steps clear and commands <i>FIRE</i> .
2 and 4	<i>RIGHT (LEFT) 10, ADD (DROP) 200.</i>	Sets off change in lead by using click sights. Traverses the tube until the vertical reticle is on the center of the target. Steps clear and commands <i>FIRE</i> .

d. Penalties. No credit will be allowed if, after each test—

(1) The incorrect lead is set on the azimuth counter.

(2) The vertical reticle is not centered on the mass of the target.

(3) The pitch and cross-level bubbles are not centered.

e. Credit.

Time in seconds, exactly

or less than 5 6 7

Credit 2.0 1.5 1.0

15-10. Direct Laying, Direct Fire Telescope

a. Scope of Test. Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below. Each group of tests will be executed as one series of commands. The candidate will be tested as the assistant gunner in the *two-man, two-sight system*.

b. Special Instructions.

(1) A stationary target will be placed approximately 600 meters from the howitzer.

(2) For tests 1 and 3, the correct range line as viewed through the telescope will be placed more than 100 meters away from the target.

(3) The laying of the piece will not be disturbed after tests 1 and 3.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1 and 3	TARGET: THAT TANK, SHELL HE, CHARGE 7, FUZE QUICK, LEAD LEFT 5, RANGE 600.	Places proper range line on the center of the visible mass of the target. Checks and adjusts for cant as required. Calls, "Set" and steps clear.
2 and 4	ADD (DROP) 200 ...	Same as test 1 above.

d. Penalties. No credit will be given if, after each test—

(1) The correct range line is not on the center of the visible mass of the target.

(2) The bubble in the cant-level vial is not centered.

e. Credit.

Time in seconds, exactly

or less than 2 3 4

Credit 2 1.5 1.0

15-11. Indirect Laying, Deflection Only

a. Scope of Tests. Eighteen tests will be conducted

in which the candidate will be required to execute commands similar to those given in *c* below. Each group of tests (test 1-9, and 1-18) will be executed as one series of commands.

b. Special Instructions.

(1) Command will not necessitate movement of motor carriage.

(2) The examiner will elect a suitable aiming point and identify it to the candidate.

(3) Command for special corrections will be given *only* in the tests indicated in the examples given in *c* below.

(4) Commands for new deflections for each test will be within the following prescribed limits:

Test No.	Maximum change (mils)	Minimum change (mils)
2 and 11	180	140
3 and 12	90	70
7 and 16	100	60
8 and 17	50	30
9 and 18	20	10

(5) The piece will be laid with the correct settings at the conclusion of each test before proceeding with the next test.

(6) For these tests, aiming posts or collimator will be set out of prescribed deflection and distances. Aiming posts will be emplaced so the near post is halfway between the far post and the sight. The far post is emplaced approximately 100 meters from the sight. The collimator is placed 4 to 15 meters from the sight with best results between 5-12 meters.

(7) The examiner will designate the section number of the piece to be used and will announce, when applicable, special corrections in deflection to be applied by the candidate.

(8) The candidate will be posted as the gunner.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1 and 10	SPECIAL CORRECTIONS, DEFLECTION 3200, NUMBER 1.	Sets deflection and applies special correction. Centers cross level and pitch level bubbles. Traverses the piece until the vertical reticle is on the left edge of the aiming posts or until the proper sight picture is read on the collimator.

Test No.	Examiner commands	Action of candidate
2 and 11	DEFLECTION 3050	Sets deflection. Leaves correction on gunner's aid counter. Lays on aiming posts, or collimator. Checks centering of bubbles. Relays if necessary. Calls "Ready" and steps clear.
3 and 12	DEFLECTION 3130	Same as test 2 above.
4 and 13	NUMBER 1 RIGHT 4	Same as test 2, except he sets right 4 on the gunner's aid counter.
	END OF MISSION (Operation is not timed.)	Sets gunner's aid counter to zero.
5 and 14	AIMING POINT, CHURCH STEEPLE, REFER.	Refers telescope to church steeple. Uncovers azimuth counter. Reads deflection and calls "Number 1, deflection ()."
6 and 15	DEFLECTION 3200 REFER	Rotates azimuth knob until reset counter reads 3200. Verifies that the vertical reticle is on the church steeple. Calls "Number 1, deflection 3200 and steps clear."
7 and 16	SPECIAL CORRECTIONS, DEFLECTION 3129 NUMBER 1 LEFT 6.	Same as test 1 above.
8 and 17	DEFLECTION 3069	Same as test 2 above.
9 and 18	DEFLECTION 3071	Same as test 2 above.

d. Penalties. No credit will be given if, after each test—

- (1) The deflection is not set correctly.
- (2) The cross-level and pitch-level bubbles are not centered.

(3) The vertical reticle of the telescope is not on the aiming point or on the left edge of the aiming post.

(4) Last motion in traverse is not from left to right.

e. Credit.

Time in seconds, exactly or less than—

Tests 1, 10, 6 and 15	12	13	14
Other tests	8	9	10
Credit	2.0	1.5	1.5

15-12. Laying for Quadrant with Elevation Counter

a. Scope of Test. Three tests will be conducted in

which the candidate will be required to execute commands similar to those in c below.

b. Special Instruction.

(1) Each test will require a change from 20 to 40 mils.

(2) Commands in tests 2 and 3 will not be in multiples of 5.

(3) Candidate will be posted as assistant gunner.

(4) The setting on the elevation counter will be within 40 mils of the initial elevation.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	QUADRANT 375	Sets quadrant on the elevation counter. Centers pitch and cross-level bubbles. Call "Ready" and steps clear.
2	QUADRANT 342	Same as test 1 above.
3	QUADRANT 363	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

- (1) The quadrant is not set accurately.
- (2) The cross-level and pitch-level bubbles are not centered.

e. Credit.

Time in seconds, exactly

or less than 4 5 7

Credit 2.0 1.5 1.0

15-13. Laying for Quadrant With Gunner's Quadrant

a. Scope of Test. Three tests will be conducted in which the candidate will be required to execute commands similar to those in c below.

b. Special Instructions.

(1) Gunner's quadrant will be set at zero for the first test.

(2) Tests 2 and 3 will require changes from 30 to 60 mils.

(3) Candidate will be posted to the left of and facing the breech and will be holding the gunner's quadrant.

(4) An assistant will elevate or depress the tube as directed by the candidate.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	QUADRANT 219	Sets quadrant elevation on the gunner's quadrant. Seats the quadrant. Directs his assistant to elevate or depress the tube until the

Test No.	Examiner commands	Action of candidate
		quadrant bubble is centered. Calls "Ready" and awaits verification of the laying.
2	QUADRANT 257	Same as test 1 above.
3	QUADRANT 204	Same as test 1 above.

d. *Penalties.* No credit will be allowed if, after each test—

- (1) Quadrant elevation is not set correctly.
- (2) Quadrant is not properly seated.
- (3) Quadrant bubble is not properly centered.

e. *Credit.*

Time in seconds, exactly

or less than 6 7 8

Credit 2.0 1.5 1.0

15-14. Displacement Correction

a. *Scope of Test.* One test, consisting of two parts, will be conducted in which the candidate will be required to execute the commands given in c below.

b. *Special Instructions.*

(1) Aiming posts or the collimator will be set out at prescribed distances.

(2) An assistant, selected by the candidate, will be stationed near the far aiming post, or the collimator.

(3) The examiner will require the candidate to lay the piece on an announced deflection and report, "I am ready."

(4) The motor carriage or the far aiming post will then be moved or the collimator rotated, so that an aiming post displacement of 5 to 10 mils occurs.

(5) The laying of the piece at the termination of part I will not be disturbed for part II.

c. *Outline of Test.*

(1) *Part I.*

Examiner commands	Action of candidate
CORRECT FOR DIS- PLACEMENT	Lays the piece so that the far aiming post appears midway between the near aiming post and the vertical crosshair of the telescope, or lays the piece so that the vertical crosshair of the telescope is in its proper position to the zero line when using the collimator. Checks centering of level bubbles. Re-lays if necessary. Calls "Ready" and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POSTS	Sets 3200 on the azimuth reset counter dial and directs assistant in aligning aiming posts, or collimator. Calls "Ready" and steps clear.

d. *Penalties.* No credit will be allowed for either part if—

(1) *Part I.*

(a) The far aiming post does not appear midway between the near aiming post and the vertical crosshair of the telescope, or incorrect sight picture is read on the collimator.

(b) The bubbles are not centered.

(c) The last motion of traverse was not made to the right.

(2) *Part II.*

(a) The deflection on the azimuth reset counter dial is not at 3200.

(b) The aiming posts are not properly alined.

(c) The vertical crosshair of the telescope reticle is not on the left edge of the aiming posts, or on the zero line of the collimator.

e. *Credit.* Part I, time in seconds, exactly, or less than—

	3	4	5	6.
Credit	3.0	2.0	1.5	1.0

Part II, no time limit

Credit 1.0

15-15. Measuring Site to the Crest

a. *Scope of Test.* One test will be conducted.

b. *Special Instructions.*

(1) The howitzer, prepared for action, will be placed 200 to 400 meters from a mask of reasonable height.

(2) The tube will be pointed 100 to 150 mils above the crest and 100 to 150 mils to the right or left of the highest point on the crest.

(3) The candidate will be posted at the rear of the breech.

(4) An assistant will traverse and elevate the tube as directed by the candidate.

c. *Outline of Test.*

Action of candidate	Examiner commands
MEASURE SITE TO CREST	Sights along lowest element of the bore and directs the movement of the tube until the line of sight just clears the highest point of the crest. Centers the cross-level and pitch-level bubbles. Reads the elevation from the elevation counter. Reports "Number (), sight to crest ()."

d. Penalties. No credit will be allowed if—

(1) The line of sight along the lowest element of the bore does not just clear the highest point of the crest.

(2) The cross-level and pitch-level bubbles are not properly centered.

e. Credit.

Time in seconds, exactly

or less than .. 14	15	16	17
Credit	4.0	3.0	2.0
			1.5

15-16. Measuring Quadrant

a. Scope of Test. One test is conducted.

b. Special Instructions. Prior to the test the examiner will lay the tube at a selected quadrant and will set the gunner's quadrant to zero.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE THE QUADRANT	Places gunner's quadrant on the quadrant seats on the breech ring. Levels the bubble on the gunner's quadrant by raising the index arm and turning the micrometer knob. Announces "Number () quadrant ()" and hands quadrant to examiner.

d. Penalties. No credit will be allowed if—

(1) The quadrant bubble is not centered when the quadrant is properly seated.

(2) The quadrant is not announced correctly.

e. Credit.

Time in seconds, exactly

or less than	8	10	11
Credit	4.0	3.0	2.0

15-17. Measure Deflection

a. Scope of Test. One test is conducted.

b. Special Instructions.

(1) The piece will be laid on the aiming posts or collimator.

(2) An aiming point within 200 mils left or right of the aiming posts or collimator will be designated and will be identified by the candidate.

c. Outline of Test.

Examiner commands	Action of candidate
NUMBER 1, AIMING POINT THAT (MARKER) REFER.	Centers the cross-level and pitch-level bubbles. Refers to aiming point. Reads deflection from the azimuth counter and reports "Number 1, deflection ()," and steps clear.

d. Penalties. No credit will be allowed if—

(1) The cross-level and pitch-level bubbles are not centered properly.

(2) Vertical reticle of the telescope is not on the aiming point.

(3) Deflation is not announced correctly.

(4) The weapon is traversed.

e. Credit.

Time in seconds, exactly

or less than	5	6	8
Credit	4	3	1.5

15-18. Tests and Adjustments of Sighting and Fire Control Equipment

a. Scope of Tests. Five tests will be conducted in which the candidate will be required to—

(1) Demonstrate the testing methods and authorized adjustments of sighting and fire control equipment.

(2) Describe the action taken (send to support maintenance) if adjustment is not authorized by the user.

b. Special Instructions.

(1) The piece will be prepared for tests as indicated in paragraph 9-2 of this manual.

(2) Necessary items of equipment are boresights, testing target, gunner's quadrant, and plumb line.

(3) An assistant will elevate or depress the tube at the direction of the candidate during tests 1 and 2 and will align the testing target for test 5.

(4) Tests will be conducted in numerical order.

(5) The gunner's quadrant used for tests 1 and 2 will be used for tests 3 and 4, with the correction determined in test 1, provided the correction does not exceed 0.4 mil.

(6) Adjustments on the telescope mount M145 and linkage are as prescribed in TM 9-2350-217-10.

(7) Tube will be leveled after test 2 and will not be disturbed thereafter.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST ON THE GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 9-4. "Correction () mils.

Test No.	Examiner commands	Action of candidate
2	PERFORM MICROMETER TEST ON THE GUNNER'S QUADRANT.	quadrant serviceable, (unserviceable)" and hands the quadrant to the examiner. Performs test as prescribed in paragraph 9-5. Calls "Quadrant micrometer is (is not) in error."
3	TEST PANORAMIC TELESCOPE MOUNT AND LINKAGE.	Performs tests and makes adjustments as prescribed in TM 9-2350-217-10. Calls "Ready" when tests and adjustments are complete.
4	PERFORM ORIENTATION CHECK ON THE ELEVATION QUADRANT M15.	Performs check as prescribed in TM 9-2350-217-10. Calls "Ready" when check is complete.
5	BORESIGHT THE HOWITZER.	Performs tests and makes adjustments as prescribed in chapter 8. Calls "Ready" and steps clear.

Note. Level the tube at conclusion of test 2.

d. Penalties. The tests are not essentially speed tests. The prescribed times are to insure that the candidate performs the tests without wasted effort.

(1) *Test 1.* No credit will be allowed if —

(a) The bubble in the gunner's quadrant does not center when checked by the examiner.

(b) The error (one-half of the angle that was indicated when the quadrant was first reversed and the bubble was centered, using the index arm and the micrometer knob) is not announced correctly by the candidate.

(c) The candidate fails to declare the quadrant unserviceable if the error exceeds 0.4 mil or fails to declare the quadrant serviceable if the error is 0.4 mil or less.

(d) The time to complete the test exceeds 2 minutes.

(2) *Test 2.* No credit will be allowed if—

(a) The procedure is not followed correctly.

(b) The time to complete the test exceeds 1 minute.

(3) *Test 3.* No credit will be allowed if—

(a) The procedure is not followed correctly.

(b) The checks and adjustments are not accomplished at quadrants 416,858 and 1,300 mils in sequence.

(c) The candidate does not declare the telescope mount unserviceable if the readings disagree more than 0.5 mil.

(d) The candidate does not adjust linkage within prescribed limits.

(e) No time is prescribed for this test.

(4) *Test 4.* No credit will be allowed if —

(a) The procedure is not followed correctly.

(b) Candidate fails to notify the examiner if the reading on the gunner's quadrant disagrees more than 0.5 mil with the elevation quadrant.

(c) No time is prescribed for this test.

(5) *Test 5.* No credit will be allowed if—

(a) The candidate fails to make indicated adjustments.

(b) The candidate does not adjust azimuth counter to read exactly 3,200.

(c) The direct fire telescope mount slip scales are not set at elevation 4, azimuth 4.

(d) The time to complete tests and adjustments exceeds 5 minutes.

e. Credit. If tests and adjustments are within prescribed limits, maximum credit will be given as follows:

Test	Points
1	1
2	1
3	3
4	2
5	3

Maximum credit 10

15-19. Materiel

a. Scope of Tests. Three tests are performed.

b. Special Instructions.

(1) *Tests 1 and 2.* A paulin will be placed on the compartment floor for layout of disassembled parts. The candidate will be allowed to select the tools prior to the test. The candidate may have an assistant to aid him in moving the breechblock.

(2) *Test 3.* A complete set of lubrication equipment and lubricants authorized for use by battery personnel will be made available. Lubricants will be clearly marked.

c. Outline of Tests.

Test No.	Examiner commands	Action of candidate
1	DISASSEMBLE BREECHBLOCK ASSEMBLY.	Performs operation as prescribed in TM 9-2350-217-10. Identifies all parts to the examiner.
2	ASSEMBLE BREECHBLOCK.	Performs operation as prescribed in TM 9-2350-217-10.
3	PERFORM DAILY AND QUARTERLY LUBRICATION.	Selects proper lubricants and equipment. (Actual lubrication is not performed.) Checks all lubricant levels.

d. Penalties.

(1) The tests are not speed tests; however, times are prescribed to insure that the candidate performs the tests without wasted effort.

(2) No credit will be given if the following time limits are exceeded:

<i>Test</i>	<i>Time [minutes]</i>
1	8
2	12
3	5

(3) One-half point will be assessed for each component incorrectly identified in test 1. There are no prescribed times for identifying the components. However, the examiner may reduce the grade if the

candidate demonstrates obvious unfamiliarity with the components.

(4) One-half point will be assessed for each lubrication point missed, each lubricant improperly selected, and each lubricating device improperly selected.

e. Credit

<i>Test</i>	<i>Points</i>
1	3
2	3
3	4
Maximum credit	10

APPENDIX A

REFERENCES

1. Army Subject Schedule (ASubjscd)

6-13A10 MOS Technical Training of Cannoneer.

2. Army Regulations (AR)

310-25 Dictionary of United States Army Terms.

310-50 Authorized Abbreviations and Brevity Codes.

385-63 Regulations for Firing Ammunition for Training Targets Practice, and Combat.

611-201 Enlisted Career Management Fields and Military Occupational Specialties.

672-5-1 Awards.

750-1 Army Material Maintenance Concepts and Policies.

3. Army Training Program (ATP)

6-100 Field Artillery Cannon Units.

4. Army Training Test (ATT)

6-157 Field Artillery Howitzer Battery, Light or Medium, Towed or Self-Propelled.

5. Department of the Army Pamphlets (DA PAM)

108-1 Index of Motion Pictures and Related Audio-Visual Aids.

310-series Index of Military Publications.

350-31-2 Operator's Training Course—Combat Vehicles Self-Propelled Artillery.

6. Field Manuals (FM)

FM 5-15 Field Fortifications.

FM 5-25 Explosives and Demolitions.

FM 6-20 Field Artillery Tactics and Operations.

FM 6-40 Field Artillery Cannon Gunnery.

FM 6-125 Qualification Tests for Specialists, Field Artillery.

FM 6-140 Field Artillery Organizations.

FM 20-22 Vehicle Recovery Operations.

FM 21-5 Military Training Management.

FM 21-30 Military Symbols.

FM 21-40 Chemical, Biological, Radiological and Nuclear Defense.

FM 21-41 Soldier's Handbook for Defense Against Chemical and Biological Operations and Nuclear Warfare.

FM 21-60 Visual Signals.

FM 22-5 Drills and Ceremonies.

7. Firing Tables (FT)

155-AH-2 Cannon, 155mm Howitzer, M126E and M126 on Howitzer Medium, Self-Propelled: 155mm, M109.

155 AJ-2 Firing Tables for Cannon, 155mm Howitzer, Medium, Self-Propelled, 155mm M109 Firing Projectile Atomic, XM 454.

155-AM-1 Firing Tables for Cannon 155mm Howitzer, M185 or Howitzer, Medium, Self-Propelled, 155mm, M109A1B Firing Projectile, HE, M107 Projectile, Smoke, WP M110 Projectile, Smoke, BE, M116, M116B1 (HC and colored) projectile, Gas, Persistent, H and HD, M110 Projectile, Gas, Non-Persistent, GB, M121A1 Projectile, Gas, Persistent, VX, M121A1 Projectile, Illuminating, M485A2 and M485A1.

8. Lubrication Order (LO)

LO 9-2350-217-12 Howitzer, Light, Self-Propelled, 105mm, M108 and Howitzer, Medium, Self-Propelled, 155mm, M109.

9. Technical Manuals (TM)

3-220 Chemical, Biological, and Radiological Decontamination.
9-238 Deep Water Fording of Ordnance Materiel.
9-1590 Ordnance Maintenance: Fuze Setters, M14, M22, M23, M25 and M27.
9-1290-200-14 Quadrants, Fire Control (Gunnery) W/E M1A1.
9-1300-200 Ammunition, General.
9-1300-203 Artillery Ammunition for Guns, Howitzers, Mortars, and Recoilless Rifles.
9-2350-217-10 Part I. Operator's Manual for Howitzer, Light, Self-Propelled;
9-2350-217-20 Part II. Organizational Maintenance for Howitzer, Light, Self-Propelled 105mm, M108, and Howitzer, Medium, Self-Propelled: 155mm, M109.
10-500-53 Airdrop of Supplies and Equipment, Rigging Ammunition for Low and High Velocity Drop.
11-206 Interphone Controls C-980/U and C-981/U and Intercommunication Set Control C-980 A/U.
11-2643 Intercommunication Sets AN/UIC-1, and AN/UIC-IX.
11-5830-340-12 Intercommunications Sets, AN/VIC-1 (V).
21-301 Driver Selection, Training and Supervision; Tracked Vehicles.
21-306 Manual for the Tracked Vehicle Driver.
38-750 The Army Maintenance Management System (TAMMS).
55-2350-200-12-1 Air transport of Supplies and Equipment, Howitzer M108 and M109.
750-244-7 Procedures for Destruction of Equipment in Federal Supply Classification 1000, 1005, 1010, 1015, 1020, 1025, 1030, 1055, 1090, 1095 to prevent enemy use.

By Order of the Secretary of the Army:

Official:

VERNE L. BOWERS
*Major General, United States Army,
The Adjutant General.*

CREIGHTON W. ABRAMS,
*General, United States Army,
Chief of Staff.*

Distribution:

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Table 1. Duties in Preparing for Action

Sequence	Chief of section	Gunner	Assistant Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6	Number 7	Number 8	Motor carriage driver	Section vehicle driver
1	Commands PREPARE FOR ACTION. Supervises operation throughout all sequence. Releases left spade lock and lowers spade.	Turns oil pump motor switch to ON position. Removes telescope cover.	Raises personnel seat. Removes quadrant cover. Assists Number 1 in removing breech cover.	Raises personnel seat. Removes breech cover and places it to the right of weapon. Releases right spade lock and lowers spade.		Removes section equipment and ammunition from spades. Places it to the right of the piece assisted by Numbers 4, 7, and 8.	Assists in removing ammunition and section equipment from spades and passes swab bucket and swab to Number 2.	Lays wire to executive's post.		Assists in removing ammunition and section equipment from spades.	Guides section vehicle into position for unloading ammunition. Assists in removing ammunition and section equipment from spades.	Remains in driver's compartment until spades are seated.	Drives vehicle into position and assists in unloading ammunition.
2	Directs motor carriage driver and enplaces spade. With the tube retracted (175-mm gun only) and the suspension system locked out, digs a hole for the spade.		Places retracting valve handle to RETURN position and returns tube to firing position after the spades have been dug in (175-mm gun only). Caution: Traveling locks must be hooked when moving the tube in or out of the battery.									Operates motor carriage as directed by chief of section. When the spade is dug in firmly against the earth, locks brakes and unlocks suspension system allowing road wheels to conform to the ground. Then again locks suspension system.	
3		Depresses override switch on signal from assistant gunner. Releases override switch on signal from assistant gunner.	When tube is in battery, signal gunner to press override switch. Hold valve handle in RETURN position until recuperator index is extended 0.20 inches. Signals gunner to release override switch. Returns handle to NORMAL and HOLD position.		Measures from front end of replenisher cylinder to replenisher piston rod. If measurement is less than 3-3/4 inches, gunner and assistant gunner repeat sequence 3. Operating range is between 3-3/4 and 7-7/8 inches.				Gathers covers and places them with section equipment				
4		Identifies aiming point when announced.	Moves tube to assist in releasing travel locks. Elevates tube after travel locks are released.	Release left traveling lock. Locks traveling lock in firing position.	Releases right traveling lock.	Assists in unloading and preparing ammunition.	Procures and spreads paulin to left rear of piece.	Prepares fuze setter.	Assembles aiming posts or collimator and places them with section equipment.	Procures and spreads paulin to right rear of piece.	Assists in unloading ammunition.		
5	Moves to left rear of vehicle and directs the driver in shifting the carriage if necessary. Caution: Chief of section must raise spade before shifting carriage. (Must also retract 175-mm gun tube)	Sets announced deflection on the azimuth counter dial. Signals chief of section for shifting the motor carriage if necessary to lay for direction.	Insures that the proper setting is on the correction indicator dial of the elevation quadrant.		Receives swab bucket and swab from Number 4. Opens the breech and inspects the tube, breechblock, primer vent, and gas check pad. Runs swab in chamber to remove muzzle plug.	Assists in unloading and preparing ammunition.	Assists in unloading and preparing ammunition.	Retrieves muzzle plug and places it with breech cover.	Assists in unloading and preparing ammunition.			Shifts the motor carriage as directed by chief of section.	
6		Lays for direction and directs No. 6 in setting out aiming posts or the collimator.	Places tube at loading position.		Receives primers from No. 7.				Aligns aiming posts or collimator as directed by the gunner.	Procures primers and passes them to Number 2.			
7				Moves loader-rammer to the rear and lowers loading arm.								Assists in unloading and preparing ammunition.	

8	Verifies that the recuperator index is extended 0.20 inches (and the retracting control valve handle has been returned to the NORMAL and HOLD position) and that the piece is prepared for action and reports to the executive, NUMBER (SO-AND-SO) IN ORDER or reports any defects that cannot be corrected without delay.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	After ammunition is unloaded, moves vehicle to point indicated by chief of section. Returns to the section or performs preventive maintenance as directed by chief of section.
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Table 1

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Table 2. Duties in March Order

Sequence	Chief of section	Gunner	Assistant Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6	Number 7	Number 8	Motor carriage driver	Section vehicle driver
1	Commands MARCH ORDER. Supervises members of section throughout all sequences.	Sets telescope and mount to travel position. Positions tube in center of traverse.	Depresses tube to travel position and sets elevation quadrant to travel position.	Rotates loader-rammer to stowed position. Locks left traveling lock in traveling position.	Inspects the chamber to insure that piece is not loaded and closes the breech. Locks right traveling lock in traveling position.	Assists in loading ammunition and equipment.		Recovers wire and stows communication equipment.	Recovers aiming posts, or collimator.		Guides section vehicle into position and assists in loading ammunition and equipment.	Starts engine of motor carriage and checks gages for proper functioning.	Drives vehicle to section area and assists in loading ammunition and equipment.
2			Retracts the tube to traveling position, making sure that the retracting control valve handle is returned to the NORMAL and HOLD position after the tube has been retracted. (175mm Gun only)		Passes swab bucket and swab to No. 4. Passes primers to No. 7.		Receives swab bucket and swab from No. 2.	Assists in loading ammunition and equipment.	Passes covers to appropriate members of section and replaces muzzle plug.	Receives primers from No. 2.		Unlocks lockout suspension.	
3	Directs motor carriage driver to move carriage forward to unseat spades						Recovers paulin from left rear.		Assists in loading ammunition and equipment.	Recovers paulin from right rear of piece.		Moves motor carriage forward as directed by the chief of section.	
4		Replaces telescope cover.	Replaces elevation quadrant cover.	Replace breech cover.		Attaches ammunition and section equipment to the spade assisted by No. 4, 7, and 8.	Assists in attaching ammunition and section equipment to the spade.		Assists in attaching ammunition and section equipment to the spade.	Assists in attaching ammunition and section equipment to the spade.			
5	Elevates spade to travel position and locks left spade lock.	Turns oil pump motor switch to OFF.		Locks right spade lock.									
6	Verifies that the piece is prepared for traveling and reports to the executive, number) SO-AND-SO) IN ORDER or reports any defects that the section cannot remedy without delay.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.	Takes post.		

Table 2

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Table 3. Duties in Firing

Sequence	Chief of section	Gunner	Assistant Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6	Number 7	Number 8	Motor carriage driver	Section vehicle driver
1	Directs work of section throughout all sequences.	Sets the announced deflection on the azimuth reset counter dial and centers the bubble in the cross-level level vial.	Sets the announced quadrant on the elevation counter dial and elevates or depresses the tube to the loading position.	After No. 2 has opened the breech, rotates the loader-rammer to the rear and lowers the loading arms.	Opens the breech and inspects the bore.	Installs the projectile on the loading tray assisted by No. 4.	Assists No. 3 in installing the projectile on the loading tray.	Fuzes the projectiles and sets fuzes assisted by No. 6.	Assists No. 5 in fuzing projectiles.	Prepares powder charges assisted by No. 8 and the motor carriage driver. When firing charge 1, the igniter tube should be removed, leaving the black powder igniter bag inside the charge (175-mm gun).	Assists No. 7 in preparing powder charges.	Assists in preparing powder charges.	Assists in preparing ammunition powder charges.
2				Assisted by No. 2, moves the loading trough forward to the breech ring. <i>Caution: Do not swing rammer with projectile hanging from rack.</i>	Assists No. 1 in moving the loading trough forward.	Assisted by No. 4, moves the projectile to the rear of the piece and attaches the loading tray to the loading arms.	Assists No. 3 in moving the projectile to the piece.						
3	Directs hand ramming of the projectile when the power rammer fails. Insures that the springs in the loader-rammer are released so that the pins in the crank do not break.			Raises the loading tray and projectile to the loading trough and rams the projectile. (Open valve fully and keep open until projectile is seated. This provides uniform ramming.) Assists No. 2 in loading the powder charge.	Receives powder charge from No. 7 and 8. Assisted by No. 1, loads the powder charge. (When firing charges 1 and 2, place powder so that it will be just forward of the mushroom head when the breech is closed. Measures depth of ram.					Moves the powder charge to the piece assisted by No. 8, passes it to No. 2, and calls out the number of the charge.	Assists No. 7 in moving the powder charge to the piece.		
4				Moves the loading trough to the rear assisted by No. 2, and rotates the loader-rammer to the stowed position. (Keep rammer control handles covered when not in use.)	Assists No. 1 in moving the loading trough to the rear and closes the breech when the loader-rammer has been stowed. Inserts the primer and slides block assembly up to position firing mechanism over primer. Calls PRIMED.								
5	Insures that the weapon is ready to fire. Indicates to the executive that the weapon is ready to fire by raising arm and/or announcing NUMBER (SO-AND-SO) READY.	Traverses the piece to the announced deflection, insures that the bubbles are centered, and announces (signals) READY after the assistant gunner has announced SET. <i>Warning: Position knees so that they are out of reach of the manual traverse and elevating cranks.</i>	Elevates the piece to the announced quadrant, insures that appropriate settings are on the elevation quadrant and that bubbles are centered, and announces SET.	Removes loading tray.	Attaches the lanyard after tube has been traversed and elevated to proper deflection and elevation and the gunner calls READY.	Receives loading tray from No. 1.							
6	On command of the executive, commands FIRE and/or lowers arm.				Fires the piece at the command of the chief of section.								

7		Elevates or depresses the tube to the loading position. <i>Note. Listen to electric motor for hydraulic pump. If it starts to drag, shut off all electrical equipment, and start engine to recharge batteries. Weapon may be fired with engine running.</i>	No. 1 repeats step in number 1.	Opens the breech and checks to insure that the spent primer has been ejected. Swabs the powder chamber, inspects the bore and if clear, calls BORE CLEAR.
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Table 7. Duties in Inspection and Maintenance

Sequence	Chief of section	Gunner	Assistant Gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Number 6	Number 7	Number 8	Motor carriage driver	Section vehicle driver
1	Supervises activities of all members of the section in all sequences.	Inspects for condition, functioning, and security of panoramic telescope and telescope mount.	Checks for condition, functioning, and security of elevation quadrant.	Remove breech cover and inspect for tears, wear, and broken or missing fasteners.		Inspects tools stowed on rear of spade and rear of hull. Checks towing pintle for cracks, breaks, and ease of operation.	Assists No. 3 in inspecting section equipment.	Checks machinegun and emergency rations.	Checks for proper storage of ammunition and equipment on section vehicle and assists section vehicle driver in inspection and maintenance of the section vehicle.			Checks fuel oil, and transmission levels.	Inspects vehicle and performs maintenance as prescribed in applicable technical manual assisted by No. 6, 7, and 8.
2	Check recoil system and directs No. 1 to service same if necessary.	Checks functioning of night lighting device for panoramic telescope.	Check and release right travel lock.	Turn hydraulic pump switch ON.	Services recoil system if directed to do so by the chief of section.	Check track tension of left track.	Check track tension of right track.					Checks and releases left travel lock.	
3	Verifies presence of technical manuals, lubricating order, and equipment log book.	Check battery for proper electrolyte level, and cleanliness.	Checks functioning of night lighting device for elevation quadrant.		Returns tube to firing position and check for smoothness of operation (175-mm gun only).	Check fixed fire extinguisher of left side of the piece.	Assists motor carriage driver in inspecting operation of lights.					Check operation of lights and horn assisted by No. 4.	
4	Releases spade locks and lowers spade, checking for smoothness of operation.	Check operation of elevating and traversing controls.	Checks operation of elevating controls.	Check operation of loader-rammer.	Opens breech and checks breech block, chamber, and tube and closes breech.		Inspect vehicle hull and cleans periscopes.					Checks vehicle instruments and controls.	
5		Boresights the piece.	Assists the gunner in boresighting.		Check portable fire extinguisher.	Assists the gunner in foresighting the piece.						Checks fixed fire extinguisher in driver's control compartment.	
6	Returns spade to travel position and lock spade locks.	Check fixed fire extinguisher on left top of carriage. Assisted by No. 1.	Locks right travel lock and checks portable fire extinguisher on right top of carriage.	Assists gunner in checking the fixed fire extinguisher.	Retracts tube to travel position.							Locks left travel locks.	
7	Reports to the battery executive, NUMBER (SO-AND-SO) IN ORDER or reports any defects which the section cannot remedy without delay.	Reports "Gunner ready".	Reports "Assistant gunner ready".	Reports "No. 1 ready".	Reports "No. 2 ready".	Reports "No. 3 ready".	Reports "No. 4 ready".	Reports "No. 5 ready".	Reports "No. 6 ready".	Reports "No. 7 ready".	Reports "No. 8 ready".	Reports "Motor carriage driver ready".	Reports "Section vehicle driver ready".

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After Operation										
1	Supervise maintenance and inspection by all members of the section in all sequences.	Clean and test panoramic telescope and mount.	Clean and test elevation quadrant and mount.	Clean and lubricate loader-rammer.	Clean and lubricate breech mechanism.	Clean and lubricate tube.	Inspect, clean, and lubricate machinegun.	Checks for proper storage of ammunition and equipment on section vehicle and assists section vehicle driver in inspection and maintenance of the section vehicle.	Idles engine properly before stopping. Observes instruments and warning light while engine idles. Shuts off master switch. Checks fuel and oil levels. Looks for leaks in engine compartment. Checks spare containers for content. Checks fuel filters for leaks and drains high and low pressure filters. Operates lights and horn (if tactical situation permits). Cleans battery, checks water level, and inspects terminals for corrosion, tightness, and coating of grease. Completes vehicle operation record.	Inspects vehicle and performs maintenance as prescribed in applicable technical manual assisted by No. 6, 7, and 8.
2	Clean and test gunner's quadrant.	Cleans and tests traversing and elevating mechanisms on the left side of the carriage.	Cleans and tests elevating mechanisms on right side of the carriage.		Cleans, lubricates, and tests firing lock.	Checks track tension of left track and inspects road wheel and idler hubs for over-heating.	Checks track tension of right track and inspects road wheels idler hubs for over-heating.	Inspect and clean communication equipment.		
3	Inspects recoil system and directs No. 1 to service same if necessary.	Assists chief of section in supervising maintenance.		Services recoil system if directed by the chief of section.		Inspect vehicle hull, spade locks, and towing pintle.	Cleans periscopes.	Checks emergency rations.		
4	Posts equipment log book and verifies the presence of all forms and manuals.				Inspect portable fire extinguisher.	Inspect & clean section equipment.				
5	Reports to battery executive, NUMBER (SO-AND-SO) IN ORDER, or reports any defects that cannot be corrected without delay.									

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